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Reimagining Urban Public Spaces Through Digital Art: A Framework For Cultural Engagement And Inclusive City-Making In Hangzhou, China

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Abstract:
Integration of digital technologies in public art installations has a significant potential for the transformation of urban spaces, however many of such initiatives have failed in leaving a lasting impact. Absence of a uniform design framework for connecting the intents of the artist with the technological execution, becomes one of the key challenges. The present study endeavors to fill the identified gap with the introduction to a seven-phase design framework for guiding the execution, public value as well as the sustainability of digital art within public sphere. The study uses the case study method under the qualitative research strategy in Hangzhou, China, to conduct semi-structured interviews with digital artists and representatives from technology enterprises. The research utilizes the NVivo analytical tool for analyzing the interview data, forming the structured framework that includes Requirements Analysis, Design Conceptualization, Technical Implementation, User Experience Testing, Optimization, Implementation and Maintenance, and Post-Installation Evaluation. The framework foregrounds the vitality of interdisciplinary collaboration, technology adaptability and user-centred design. The framework shall provide practical suggestions encouraging cultural engagement, promoting inclusive form of community participation, along with encouraging social innovation and sustainability at the economic level. The findings contribute towards the policy strategies of urban culture of incorporating digital art into urban development, aligning artistic creativity with technological strength. This study offers important insights for policymakers and practitioners with the aim for harnessing digital public art for cultural revitalization and sustainable urban innovation.
Keywords: *Digital public art; Urban cultural policy; Design framework; Social innovation; Cultural economy; Community engagement*

1. INTRODUCTION

Digital art is transforming our experience of the cities. Art is not limited to galleries or museums only, it now appears on walls of buildings, public plazas, and streets. It has transformed everyday places into creative and interactive spaces. Globally, city planners and cultural leaders are opting for digital public art for it has the capacity to breathe live into urban areas, attract tourism, and deepen the cultural connection. The installation of digital art can symbolize the identity of a city along with providing a blend of innovation as well as expression. However, success is not depended only on the cutting edge technology and creative ideas but it depends on the thoughtful planning that centralizes communities. Digital art projects often fail to live up to their goals as the creative vision, technical realities, do not blends with the needs of local residents. This lack of connection makes it tough for projects to produce real impact. Research studies in urban development and public art showcases the ways in which art can drive renewal of a neighbourhood along with strengthening a sense of place. Culture-driven revitalization often leads artists to rethink shared public spaces, generating social as well as economic benefits (Baek et al., 2021). Digital tools tend to expand the possibilities, making experiences more immersive and accessible widely along with bringing new challenges.

Projects which utilizes augmented or virtual reality, for instance, show the ways in which digital layers can enrich public spaces (Lee et al., 2021; Hurst et al., 2023). However, these efforts succeed only when artists, technologists, and policymakers collaborate together since the beginning of the project. Without a clear collaborative approach, projects get fragmented for example, leaning too much on technology or on aesthetics while missing the balance required for sustainability and public support. There persists a lack of integrated models that brings artistic as well as technical elements together (Bettivia & Stainforth,

2023). Other vital concerns such as ways in which the project is managed, or checking accessibility of the project, and the manner in which it fits into the local culture, are often undermined, hence weakening the long-term value of such projects (Saleh et al., 2022).

The present study responds to the identified gaps by proposing a design framework that shall be tailored for digital public art in urban spaces. The research focuses on Hangzhou, China, a city rich in tradition along with being at the forefront of the digital economy. This setting offers a unique opportunity to explore the ways in which technology and culture can be intertwined in public space. Through conducting conversations with local artists, tech experts, and planners, the research develops a seven-phase framework that interconnects artistic intent with practical delivery. It emphasizes collaboration of different fields, consistent input from communities, and long-term care being crucial for making public digital art to be meaningful and enduring. The framework, by aligning with the urban cultural policy and creative goals for cities, shall provide a working guide for its readers who are involved in shaping public art ranging from artists to urban planners. The aim of the framework is to help artists and planners to co-create spaces that are inclusive vibrant as well as futuristic in its approach. The paper will explore relevant literature along with explaining the undertaken research process. Further, the Hangzhou case study shall be discussed and lastly the paper will reflect on the vitalitty of the framework for social innovation and city planning.

2. LITERATURE REVIEW

The increased rate of fascination among the public for digital art in public spaces delineates attempts of cities to integrate cultural aspects with technologies. Scholars have been exploring the impact of digital installations on culture of urban cities, community engagement, and the development of shared spaces. Cultural regeneration theories state that art could bring about urban revitalization along with social inclusivity (Baek et al., 2021), and digital art offers new approaches to fulfil these goals. Recent research has indicated that interactive media facades, projection mapping, and AR/VR art change experiences of an individual of urban environments by blending the physical with the virtual realms (Lee et al., 2021; Hurst et al., 2023). These initiatives emphasize the ways in which immersive digital art can improve individual experiences of urban life, promote social ties, along with redefining local identity. However, academic discussions have also revealed substantial challenges in the real world. One of the prominent challenges is the lack of a integrated design framework that addresses the technical and artistic integration in digital public art projects (Bettivia & Stainforth, 2023). While technology-centred projects place a higher priority on prototype, usability, and maintenance, traditional public art techniques frequently concentrate on aesthetic considerations, community dialogue, and site-specific aspects. Bridging these realms is essential for digital public art, yet much current research has examined artistic achievements and technological systems mostly in isolation. For instance, some scholars investigate the unique user experiences created by digital art, while others analyze smart city technologies and infrastructure; few efforts combine these viewpoints. Saleh et al. (2022) emphasize that integrating digital public art into historical urban environments must balance innovation with contextual sensitivity – a challenge that requires a guiding framework.

The literature highlights a clear need to make digital art in public spaces more attracting and easy to engage with—for everyone. That includes people who may not be comfortable with technology or who have different abilities. Studies on digital placemaking stress how crucial it is to involve communities in the design process. When people help shape these projects, the results are more likely to reflect local values and truly meet the needs of the community (Cuomo et al., 2021). Inclusion pertains not just to audiences but also to the active involvement of local artists and stakeholders in the design process. Studies on culture-driven urban development highlight that collaborative approaches – engaging residents, artists, and officials – improve community acceptance and maintain impact (Baek et al., 2021). These findings suggest that a robust framework for digital art in urban environments should integrate community involvement and feedback mechanisms (e.g., user testing phases) as integral components of the process.

Furthermore, prior studies have not sufficiently examined the relationship among digital art, local economies, and governmental frameworks. Evidence suggests that dynamic cultural installations can revitalize urban economies by drawing in tourists and boosting the creative sectors (Cuomo et al., 2021;

López Baeza et al., 2021). As part of the creative economy, digital art installations can enhance city branding and add value to the experience economy, where unique cultural encounters are treated as valuable commodities (Godovykh & Tasci, 2020). Cultural policies in many progressive communities are starting to embrace digital media as a means of presenting a contemporary identity, engaging younger generations, and enhancing the relationship between local technology and the arts. However, despite increased attention, there is still a lack of direction in the literature regarding how these initiatives might be effectively incorporated into the frameworks of established urban planning and policy.. By merging ideas from digital transformation, innovative urban design, and creative placemaking, we propose a comprehensive framework to guide digital public art projects in an artistically engaging, technically proficient, and socially inclusive manner, building on prior conceptual work in this field (Liu & Hamid, 2023). This study aims to fill these gaps by presenting a structured process model that can be used to urban cultural policy and planning, offering that digital public art projects are planned and delivered with an appropriate combination of originality, technological excellence, and community participation. The following section outlines the methodology used to develop the framework, which is intended to benefit Hangzhou city council policymakers and stakeholders.

3. METHODOLOGY

This research employed a qualitative case study method to establish and validate the proposed design framework. Hangzhou, China, was selected for the case study due to its reputation as a technologically advanced city with a rich cultural heritage. The authors conducted in-depth, semi-structured interviews with a focused sample from Hangzhou's digital art community and supporting literatures. There were fifteen participants in all, ten of whom were digital artists and five of whom were representatives of technology businesses that specialize in digital art and related technologies. The group of artists selected comprised ones exclusively working in digital media along with those who were switching from traditional forms of art to digital platforms. The group offered a wide variety of artistic viewpoints. The technology representatives belonged to five sectors related to digital public art: software development, technical equipment provision, AR/VR system creation, digital content production, and interactive design, symbolizing the interdisciplinary nature of such projects.

The interviews were conducted following a scheduled procedure that focused upon important topics such as participant design processes, challenges encountered during the production of digital art installations, ways in which technology affects creative production, as well as strategies of audience engagement. Interview respondents were encouraged to provide more detailed responses with the use of open-ended questions, about their experiences and suggest improvements or requirements for the progress of digital art in public spaces. The duration for each interview was approximately 60-90 minutes, and the recorded responses were transcribed with scrutiny. Interviews were carried out adopting the established best practices in qualitative research strategy(Bazen et al., 2021) until the emergence of no new themes or insights,following the process of "data saturation." This guaranteed that a comprehensive as well as significant collection of responses were represented in the framework developed from the findings.

The interview transcripts were analyzed under the process of thematic analysis using NVivo 12 software. The research employed an inductive coding strategy, commencing with open coding to examine the data minutely and identify the main concepts mentioned by respondents. This process developed 163 initial codes in total from all transcripts. The codes were reviewed and broader categories were constructed that captured similar ideas, leading to the development of 18 thematic groups. Examples of these categories include "Integration of Art and Urban Planning," "Technical Challenges and Maintenance," "Audience Interaction and Feedback," and "Economic Opportunities from Digital Art." Through iterative discussions and refinement processes, the categories were further distilled and organized systematically to tally with the stages in the design process. This axial coding and categorization process developed a seven-phase design framework that outlined the comprehensive process as per the description by practitioners for successful projects of digital arts. The research tested the validity of the framework by cross-referencing the framework with the collected interview data for confirming that each phase was in lieu with the participant insights and conducted member checks, whereby selected group of respondents evaluated the framework's alignment with their experiences.

Several strategies were employed throughout the research process to ensure the credibility ans well as reliability of the study. One key approach was triangulation, achieved by examining perspectives from both artists and technologists. This helped illuminate areas of overlap as well as points of divergence, enriching the overall analysis. Hangzhou's unique position as a cultural hub and a centre of technological innovation offered an ideal setting to examine how digital art connects with urban development and cultural policy. The case study method allowed for an in-depth exploration of how these dimensions come together in practice.

Ethical guidelines were strictly adhered: all participants provided informed consent, their identities were protected through anonymization, and no conflicts of interest were reported. Although the framework was developed from a single-city case, it was deliberately designed to be conceptually adaptable—providing useful insights for digital art initiatives in other urban contexts. The next section presents the findings of our analysis and introduces the proposed seven-phase design framework.

4. FINDINGS

During the analysis of interview data, 163 initial codes were identified through a careful, sentence-by-sentence review. These were then refined by merging codes with overlapping meanings, resulting in 86 integrated codes. After removing redundant or unclear items, the data was distilled into 51 core ideas. These themes were further organized into 18 thematic categories. The classification process, detailed in Tables 1–3, was supported by NVivo software, which helped map the codes to distinct topics and facilitated structured analysis.

These categories specifically address how digital technology and digital art are used in urban settings, as shown in Table 1. The findings highlight the potential of digital tools to enrich urban culture by offering new platforms for communication, creativity, and social interaction. Digital art plays a key role in shaping the city's cultural atmosphere through public installations and interactive works. These functions are essential considerations in the design process and should be integrated from the early planning stages.

Table 1: Application of digital technology or digital art in urban operations

Encoding	Category	Initial Concept	Raw Data
11	Application of digital technology or digital art in urban operations	● intelligent and sustainable urban development; ● urban culture and socialization; ● urban tourism development; ● urban transport and logistics; ● urban planning and design; ● City management and operations	Urban culture and social interaction: Digital technology can provide digital cultural resources and social platforms to promote communication and cultural interaction among urban residents. Digital art can create a unique cultural atmosphere and social place for a city in the form of public artworks and interactive installations.

Table 2 shows the importance of developing digital art platforms to strengthen and expand the digital art ecosystem in future cities. These platforms rely heavily on digital technologies, offering artists and designers essential opportunities to showcase and sell their work. The widespread use of tools such as virtual galleries, online art marketplaces, and digital sharing platforms has significantly increased both the visibility of digital artworks and the accessibility of art to broader audiences.

Table 2: Measures to enhance the digital art scene of the city of the future

Encoding	Category	Initial Concept	Raw Data
10	Measures to enhance the digital art scene of the city of the future	● integrating digital art with urban planning; ● the introduction of innovative presentation methods such as augmented reality (AR) and virtual reality (VR); ● establishing and promoting digital art platforms; ● providing arts education and engagement opportunities; ● organizing digital art events and exhibitions; ● building digital infrastructure; ● Strengthen cooperation and exchanges; ● Enhance the experience of public art space with the help of audience data; ● innovative technology application of science and technology enterprises; ● Offering unique digital art forms and representations;	Promote digital art platforms: Establish and promote digital art platforms that provide artists and creators with opportunities to showcase and sell their work. These platforms can include virtual galleries, online art marketplaces, and artwork-sharing platforms so that more people can view and buy artworks.

In exploring how virtual spaces support digital art, we focus on the role of virtual reality technologies—especially within the framework of the Metaverse. These technologies are reshaping how we experience art, creating new modes of interaction that go beyond the limitations of traditional physical spaces. As shown in Table 3, this shift introduces a new standard for how public art spaces can be designed and experienced. Our analysis of artworks created in these contexts reveals that digital technologies are now indispensable in shaping the public art landscape.

Table 3: Categories to which the initial concept belongs

Encoding	Category	Initial Concept	Raw Data
15	Virtual spaces provide technical support for the digital art scene	● 3D modeling and rendering techniques; ● digital painting and image processing, digital art technology; ● AR technology;VR technology; ● interaction design technology ;	As far as the development trend is concerned, the virtual reality technology under the concept of meta-universe has already influenced and inevitably led to the presentation of a revolutionary new way of experiencing the

		Artificial Intelligence (AI)	traditional art space. From some of the projects we have developed together, the use of digital technology has become one of the symbols of competitiveness in the operation of public art spaces.

Building on the themes identified, we developed a comprehensive design framework to guide the creation and implementation of digital art initiatives. This framework includes a structured series of steps: from initial needs assessment and conceptual design, through technical development and user experience testing, to refinement, long-term maintenance, and post-installation evaluation. When combined, these stages encourage a more deliberate and environmentally friendly method of incorporating digital art into the urban landscape.

5. Seven-Phase Framework for Digital Art in Public Spaces

Figure 1 illustrates a comprehensive design framework developed to guide the creation and implementation of digital art installations in public spaces. The framework comprises of seven key phases, with each phase representing a critical stage in the design process.

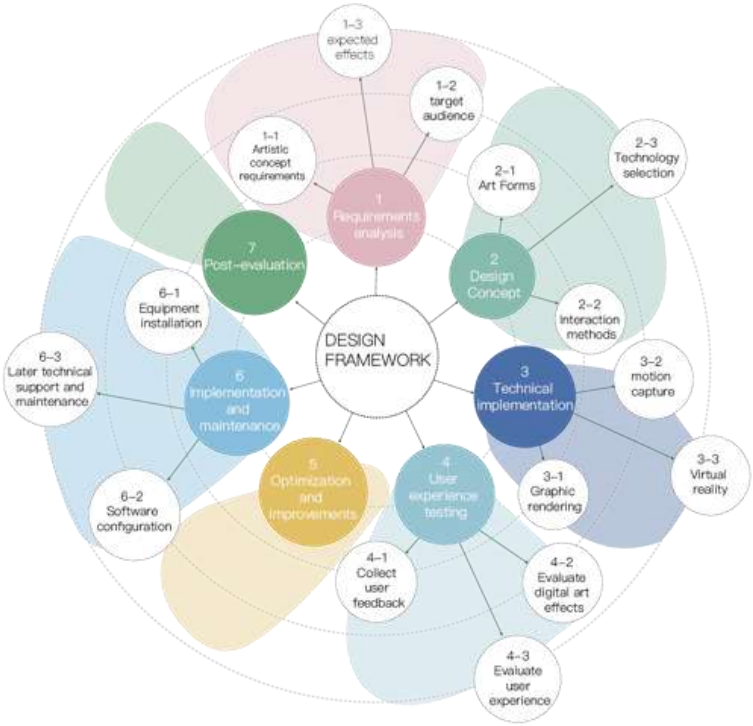

Figure 1 Seven (7) Phase Framework of Digital Art in Public Spaces in Hangzhao, China (Author's illustration)

The process of integrating digital art into urban public space is divided into seven phases, which comprise of concept development, maintenance, and post-installation evaluation. It functions as a comprehensive road map, rather than a straightforward checklist, for the management of intricate digital art projects in the urban setting. Each phase requires collaboration between artists, technologists, community individuals, and municipal officials, which has distinct objectives, activities, and stakeholders. Project team ensure that the technical execution as well as creative approach are synchronized by following the systematic sequence of identifying requirements and evaluating the public impact. Utilizing the

methodology to examine existing projects in the Hangzhou city as a case study identified the best practices that may be applied to similar initiatives in future. Based on the qualitative data collected, the Seven-Phase Framework is discussed further in detail.

Requirements Analysis: The initial phase implies broad creative ideas and visions that are transformed into concrete plans. City stakeholders (e.g. cultural officials or community representatives), artists and technologists collaborate to establish the objectives and scope of the project. This includes understanding the urban context of the selected site, the target audience, and the thematic messages or the branding goals if any. By gathering comprehensive requirements such as covering artistic intends, technical needs, regulatory compliance, community expectations, the project team outlines a groundwork which aligns the art installation with the creative vision as well as relevant strategies of urban development.

Design Conceptualization: The second phase focuses on development of the artistic concept and the experience design by building on the defined requirements. At this phase, the creative team drafts the interactive experience and plans the ways in which the audience might engage with the piece. Concepts may involve participatory elements or immersive environments (for example, virtual cityscapes or augmented reality overlays that invite public interaction). The design process is user-centred, keeping in mind the accessibility and appeal towards a broader target audience. At this stage, close collaboration between artists and designers helps ensure that the concept is innovative as well as feasible in consideration with the technical and spatial constraints. The results of this phase is an articulated design proposal or prototype that can be presented before the stakeholders and refined until it's full production.

Technical Implementation: After the approval of the concept, it is necessary to turns attention towards the technological implementation. The technical implementation stage includes engineering and production activities, such as development of software, the creation of digital content (like 3D models and animations), hardware configuration (for example, projectors, sensors, or AR/VR devices), and the integration of all of the components. There is a collaboration of the technical team with artists to ensure that the digital tools clearly reflect the vision of the artists. Significant choices are made regarding platforms (deciding between custom solutions and off-the-shelf products) and infrastructure to verify that the installation can handle the conditions of public spaces taking inbto consideration the aspects like weather, network connectivity, and public safety. This phase might also include small-scale prototypes/simulations to evaluate technical viability and mitigate any challenges before the public unveiling. For example, the choice of software tools and AI assistance for a "virtual city" art project would visualize seamless real-time rendering as a priority, guided by the thematic code group "Virtual Space Support" identified in the present research analysis.

User Experience Testing: Iterative testing with actual users or representative focus groups is necessary to be conducted before the launch of the project. In this phase, a prototype or beta version of the digital art installation is set up either on-site or in a controlled environment to collect feedback on the usability of the art and audience reactions. Participants often get engaged with the digital art work while the designers and researchers focus on the observation of the responses. Insights in regards with the comprehensibility of interactive components, the emotional as well as cognitive responses of the viewers, and any engagement hindrances such as perplexing interfaces or challenges in the accessibility are gathered. The phase is significant for it identifies the enhancements that will make the installation more engaging, inclusive as well as aligned with the intended impact. The feedback loop at this stage reflects the best practices in inclusive urban design, guiding the project team for project refinement to ensure that people from different age groups, backgrounds, and abilities enjoys the product.

Optimization: The project commences into a refinement phase based on the feedback that had been collected from user testing phase. Collaboration of artists and technologists focuses on enhancing of the aesthetic appeal and on improving the technical operation of the artwork. The process involves refinement of the visual components, promoting interactivity, enhancing the software for better functionality, reinforcement of physical elements for ensuring durability of the artwork, or integration of features like multilingual instructions for improve the accessibility of the work. The optimization stage ensures that the final installation provides an experience of a high-quality over time. Additionally, it considers practical challenges such as efficiency of maintenance and the energy consumption. At the end

of the phase, the digital art installation is thoroughly refined and fit for public deployment, with improvements internalized to maximize the impact and mitigate potential hindrances.

Implementation and Maintenance: The present phase focuses on the launch of the artwork at its public site and creation of a scheduled plan for the ongoing operations. Implementation stage involves installation of all components on-site and carrying out of final tests for the integration in the given environment. The moment the piece of art is live on social media platforms, the focus is on the maintenance of protocols that includes designating technical staff or collaboration with technical associations for the rigorous inspections, planning of content updates or software patches, as well as establishment of procedures for immediate repairs if required. Documentation from the earlier stages are used to provide training to management staff or volunteers to ensure the key factor of long-term sustainability. The phase implies that the success of a digital public art project persists not just through launch of the artwork but also on the maintenance of sustained functionality and safety. Institutional support from the urban agencies or sponsors is often vital at this phase to assure resources for maintenance throughout intended lifespan of the installation.

Post-Installation Evaluation: In the final stage, the project's results are reviewed by the stakeholders and collection of insights for future initiatives is done. This involves assessment of public responses and engagement through surveys on visitors, utilization of the analytics, feedback collected from social media platforms, and observational studies, along with determining if the installation achieved the intended targets. Was it able to attract a range of audiences and promote interaction? Did it effectively communicate its cultural message or induce public discourse? Furthermore, this phase involves the analysis of technical performance and maintenance records for identifying the best practices. There can be formal evaluations, such as research studies or official reports, or informal as well, but both are significant for understanding the project's impact on the society. The insights gained from this analysis can inform the creation of new initiatives, facilitating a cyclical process of continuous improvement. Crucially, this phase "closes the loop" with city policymakers and sponsors by showcasing the public value and cultural benefits realized, thereby rationalizing the investment and shaping future urban cultural policy decisions.

Hangzhou city is considered one of the best example that has the potential to be the future digital arts scene of the Metaverse. Digital public art in Hangzhou is multidimensional. Technology and infrastructure enable new forms of art, aesthetic design decides who is captivated, participation channels (or fails to channel) public input, and government determines whose interests are prioritised. The findings show how important these framework in determining the sustainable public spaces through digital arts in the future. Table 4 illustrates the connections among the seven phases, ranging from requirement analysis to maintenance and post-installation evaluation.

Table 4: Connections between the Framework Phases

Phase	**Objective**	**Supporting Literatures**	**Key Insight (Hangzhou Interviews)**
1. Requirements Analysis	Align artistic vision with urban policy, cultural context, and community needs.	Mapping historical landmarks (e.g., West Lake) to ensure cultural resonance. (Wang & Zhang, 2019)	"Digital art must complement urban planning to foster interaction." (Artist)
2. Design Conceptualization	Develop interactive, inclusive concepts that balance creativity and feasibility.	AR is used to overaly on Lisbon'd street art for urban cultural development (Guimarães et al. (2016)	"Audience inclusivity ensures broad engagement." (Designer)
3. Technical Implementation	Execute robust technical solutions (software, hardware) to	Jaguar framework enables large-scale mobile AR	"Bridging art and tech requires iterative

	realize the artistic vision.	with 33ms latency using edge computing. (Zhang et al., 2018)	prototyping." (Technologist)
4. User Experience Testing	Refine accessibility, usability, and engagement through iterative feedback.	Added tactile interfaces after seniors struggled with gesture controls. (Sonderegger & Sauer, 2015)	"Testing reveals barriers and enhances inclusivity." (Interviewee 7)
5. Optimization	Enhance aesthetic and technical performance for durability and sustainability.	Evaluate lighting efficiency using software and experiments to reduce public energy costs. (Lobão et al., 2015)	"Refinement ensures long-term functionality." (Technologist)
6. Implementation & Maintenance	Ensure operational longevity through careful installation, upkeep, and partnerships.	Proposes intelligent O&M model for PPP infrastructure using decision-support and tech integration (Due et al., 2021)	"Sustainability depends on institutional support." (City Official)
7. Post-Installation Evaluation	Measure cultural, social, and economic impact to inform future projects.	Explores mobile and web-based data tools to evaluate cultural tourism impact and trends (Kalvet et al., 2020)	"Evaluation closes the loop for future projects." (Policy maker)

This framework is more than just a checklist; it provides a strategic blueprint for managing intricate digital art projects in urban environments. All the phases prioritizes various types of collaboration of the artists, city officials, technologists as well as members of the community. The project teams can ensure that both the creative as well as technical efforts are in synchronization by following this structured method. For example, emphasis on the precise needs from the commencement of the project helps in aligning the goals of the artwork with the cultural strategies of the urban space. Simultaneously, the user testing phase assures that inputs from the community has a direct influence on the final product. The comprehensive approach adopted creates confidence among the stakeholders belonging to funding agencies or the public audience that the digital art installations are meticulously designed and assessed, rather than framed experiments executed in isolation. In the urban city of Hangzhou, a reflection on current projects applying the developed framework has disclosed strengths and arenas for improvements that can promote future digital art projects locally and in other urban spaces. The following section is dedicated to the exploration of the broader implications of implementing the framework, particularly focusing on the ways in which the framework can foster social innovation, economic development, as well as supportive urban policies for digital art.

5. DISCUSSION

The proposed framework of seven phases serves as a comprehensive model for the integration of digital art into urban public spaces, which effectively connects the realms of creativity and technology to assure cultural relevance as well as project sustainability. This framework addresses significant gaps in current practices, by aligning artistic intentions with technological realities and fostering interdisciplinary collaboration. This ultimately nurtures a process of city-making that prioritizes community involvement as well as flexibility. The present holistic strategy not only enhances the aesthetic as well as interactive characteristics of public spaces but also gives substantial benefits in terms of social innovation as well as economic development. It positions meanwhile digital art as a force that drives broader transformation of urban space. The research paper shall further delve into these implications in detail, assessing the

impact of the framework on social and cultural engagement, economic development, as well as on urban policy considerations.

5.1 Social and Cultural Implications

Application of the proposed design framework significantly shall impact social innovation and enrich cultural aspects in urban environments. By integrating collaboration of multiple disciplines along with community feedback, the framework ensures digital art projects serve as a platform for social interaction. In the Hangzhou city example, technology associations and artists collaborated to foster learning as well as innovation among sectors. These collaborations paves the way for creative solutions to urban issues for example utilizing digital art to showcase environmental issues or for celebrating marginalized communities. The framework creates contributions from various experts, supporting the perspective that mitigating complex urban issues requires blending artistic creativity with technological tools (Austin & Devin, 2003).

The user-centred design of the framework and repetitive testing phases actively promotes social inclusion. By involving the community feedback in the design process, through feedback sessions and customizing the experiences for a diverse range of people, the art projects developed following this framework are more accessible and rational for a broader range of users. The inclusive strategy proposed shall tackle a fundamental goal of urban cultural policy that is to assure that cultural investments are beneficial for various groups of the society and not for only the privileged ones. Digital art installations conceived within the proposed framework can highly increase the cultural vibrancy of the cities. By promoting new ways for people to interact with the urban culture, it encourages passersby to participate rather than just observe the dynamic art experiences. Engaging public art strengthens the bonds within communities by creating the space for sharing experiences and conversations among the residents as well as visitors. Furthermore, it can contribute to a city's cultural identity, for instance, a well-designed digital artwork may symbolize the local history or symbols, thereby resonating with the heritage of the community with the utilization of advanced media. The integration of tradition as well as innovation was observed in the city of Hangzhou, where participants noted that integrating elements of history into the digital art helped promoting the artwork in the local context and improved acceptance from public. Aligning to placemaking theories, such installations can change public spaces into vibrant and interactive social hubs, promoting the sense of a belonging. They may act even as landmarks that define the character of a neighborhood or embodies the progressive spirit of the city.

Additionally, the framework showcases the significance of diverse involvement, which can foster exchange between cultures and create connections at the global level. Digital art has the inherent capacity to transcend physical boundaries through online or the real-time interactions. For example, an installation of digital art may feature a digital platform or social media integration, that enables virtual interaction for individuals beyond the city. By the integration of these elements during the conceptual as well as technological phases, makers can expand the access of public art beyond local public. Such an international exposure can bring about cross-cultural interaction and increase the status of the city within the global innovation landscape. Bettivia and Stainforth (2023) argues that development of digital public spaces require a careful balance to be maintained between local contexts and wider audiences, and our framework encourages artists as well as planners to thoughtfully trace this balance, that might result in projects that are firmly internalized in the community along with inviting global participation.

Digital art initiatives meant for public consumption when viewed through the lens of social innovation can serve as grounds for testing of new civic engagement forms. These initiatives often use the novel technologies in the routine settings, that sparks interactions about public role of technology. For example, an AR installation that shows community narratives indicatively allows people residing in the area to share along with preserving intangible heritage. The framework ensures that experimental elements are responsibly implemented and refined utilizing user feedback. Therefore, city officials along with cultural institutions see digital art projects as social labs that allow participation, providing insights into public behavior, community interests, as well as technology-facilitated dialogue. This trend in policy of urban culture encourages participatory culture along with citizen co-creation in public projects. With the enhancement of cross-sector cooperation and clarifying stakeholder involvement, the framework will guide projects like the AR community narrative installation to succeed. In Hangzhou, for example,

blending historical storytelling with interactive digital art strengthened local identity and attracted broader interest. User testing, as necessitated by the framework, aligned the project with the city's inclusive goals. Overall, the framework's inclusion of collaboration and feedback reflects modern cultural policy priorities by embedding community voices and ensuring the artwork fosters collective expression and innovation.

5.2 Economic and Urban Development Implications

A structured framework can enable digital art in public spaces to deliver significant economic advantages and contribute to urban development goals. Effectively designed digital installations have the potential to draw considerable foot traffic, including tourists, which in turn enhances the local economy through greater support for nearby businesses and cultural sites. In Hangzhou, interviewees highlighted that interactive art displays emerged as popular attractions, inviting people into particular districts and promoting cultural tourism. These insights correspond with research by Cuomo et al. (2021), which showed that immersive digital experiences can heighten tourist engagement and generate value in heritage settings. Cities celebrated for their innovative public art—be it digital or traditional—frequently weave these installations into their branding strategies, cultivating an image of creativity and modernity. This can economically provide a competitive advantage in the creative economy, attracting creative industries and talent to the city.

The framework's emphasis on phases like optimization, maintenance, and evaluation ensures that digital art projects remain attractive and dependable over time, which is crucial for sustaining economic benefits. By planning for maintenance and engaging technical partners from the beginning, the framework reduces downtime and technical issues, allowing installations to function reliably for their intended duration (such as during a festival season or as a semi-permanent exhibit). This focus on reliability and durability maximizes returns for funders or sponsors, as the artwork continues to captivate audiences for an extended period. Additionally, the skills and infrastructure gained from one project (like specialized installation techniques or custom software solutions) strengthen local capacity that can be utilized in future projects, thereby fostering a thriving ecosystem for digital art production. Ultimately, each project acts as a building block that enhances a city's tech-art sector, potentially generating new job opportunities and businesses at the crossroads of art and technology.

From a commercial perspective, digital art installations also create opportunities for public-private partnerships and innovative revenue models. For example, technology companies may opt to sponsor high-profile interactive artworks to showcase their products (such as new projection systems or networking technologies), thereby alleviating costs for the public sector or artists. Alternatively, temporary digital exhibitions could be linked to local events, merchandising, or augmented reality tours that benefit local merchants. The framework encourages consideration of these economic opportunities during the early stages (requirements and conceptualization) by prompting project teams to align their goals with potential funding and revenue streams—provided these do not compromise artistic integrity or public accessibility. This balance ensures that pursuing economic value can coexist with cultural and social objectives.

An intriguing point raised by our findings is how digital art projects engage with the experience economy. Today's urban audiences often value memorable, immersive experiences as much as, or more than, physical goods (Pine & Gilmore, 1999). The user experience testing and optimization phases of the framework directly contribute to crafting such memorable experiences by refining interactivity and emotional resonance. This approach not only delights audiences but also fosters repeat participation. Visitors may return multiple times, bring friends to experience the installation, or share it on social media—in effect becoming enthusiastic promoters of the city's cultural offerings. In doing so, cities cultivate an engaged audience whose cultural consumption supports the local economy (e.g., through museum visits, guided tours, dining, and retail in the area) and builds cultural capital for the city. As highlighted by Godovykh and Tasci (2020), emphasizing the experiential aspect is crucial for fostering engagement and loyalty. In the context of public art, while we might not speak of "brand loyalty" in a commercial sense, there is a parallel in terms of civic pride and attachment. A city that consistently provides inspiring public art experiences can enhance residents' pride and positively influence visitors' perceptions, leading to indirect economic benefits via improved quality of life and city reputation.

The final evaluation phase of the framework requires analyzing economic impacts- like visitor counts, local business feedback, and media attention- alongside cultural outcomes. Over time, gathering information on how digital art installations affect foot traffic, local businesses, and even global visibility can provide city officials and investors with insights into the return on investment for these cultural projects. This data is crucial for justifying budgets and for strategic planning, establishing digital public art as a valuable investment that generates cultural, social, and economic benefits rather than merely a luxury expense. In a wider urban development perspective, the fusion of art and technology seen in these initiatives is in line with the evolution of smart cities into creative cities – urban environments that leverage technology not just for operational efficiency and infrastructure, but also to enhance cultural richness and inclusivity. The Hangzhou example demonstrates that a methodical approach to digital art can support the city's economic development objectives while also improving its cultural landscape. For example, digital art installations in Hangzhou have significantly boosted cultural tourism, with locations like the Oeeli Art Park seeing a notable increase in visitors following these projects' implementation. Emphasizing maintenance and evaluation, the framework strengthens policymakers' ability to justify expenses with demonstrated returns and community benefits, while fostering sustained public-private partnerships for future initiatives.

5.3 Policy Implications and Public Value

The study's conclusions are essential for stakeholders, including governments, because they guarantee that city-led art programs enhance public value and urban cultural policy. While numerous cities have public art programs or cultural master plans mainly concentrating on traditional art forms, our framework guides policymakers to tackle digital art initiatives comprehensively. For instance, guidelines in cultural policy could mandate that any city-funded digital installation project outline its approach across the specified phases, ranging from community consultation (Requirements Analysis) to maintenance strategies and impact evaluation. By incorporating such standards into policy or grant-making processes, cities can foster better-designed projects more prone to yielding public value and producing wide-ranging societal benefits relative to their costs. A key policy challenge in digital public art involves the coordination among various departments and stakeholders, including arts councils, technology providers, urban planners, maintenance teams, and the public. The framework employs an interdisciplinary approach to address this issue by defining roles and collaboration points at each stage. Policymakers can utilize the framework to form interdepartmental task forces for digital art initiatives, ensuring early involvement of the IT or smart city department for technical execution, as well as the parks and public works departments in site selection and maintenance from the start. This proactive coordination, guided by the framework's clear timeline on when each party should participate, can help mitigate common challenges. For example, it can avert situations where a technological installation breaches public space regulations due to insufficient early planning input, or where an artwork is neglected because of unclear maintenance responsibilities. Ultimately, the framework promotes a more holistic approach to public art governance, aligning with contemporary urban governance principles that emphasize collaboration, innovation, and inclusivity.

Integrating the framework into cultural policy demonstrates commitment to community engagement and transparency in public art development. Following the planned phases allows city authorities to ensure that each digital art display involves public feedback throughout both the design and testing stages, as well as being evaluated for its impacts, which are critical parts of responsible governance. This strategy boosts public trust in experimental programs that use shared community spaces or public financing, because locals know their ideas are acknowledged and that the results will be evaluated. Additionally, the post-installation evaluation (Phase 7) stage gives the policymakers a better insight of what resonates their local community which allows for evidence-based improvement approach. This data-driven policy improvement approach is projected to increase the positive effects of public art investments by better matching them with goals such as social inclusion, cultural education, and neighbourhood revitalisation. The data-centred approach for the policy improvement is expected to boost the positive effects of digital public arts investments which align with their objective of social inclusion, cultural education and neighbourhood revitalization.

Cultural policy is based on the idea of public value, which includes the advantages that public projects provide to society. Aesthetic pleasure, cultural education, societal pride, social cohesiveness, and even motivation for technology growth are some of the ways that public value manifests in digital public art. The framework enhances public value creation by adding the most important considerations into each step of a project. For example, including user experience testing ensures the audience's opinions are considered. This not only makes the work more engaging and consumable but also increases its social influence and educational worth. Additionally, including a post-installation review captures and disseminates insights about public benefits or shortcomings. Policymakers aiming to justify investments in creative technology projects can use this structured approach to demonstrate that robust measures are in place to yield meaningful public benefits. If a city's cultural policy outlines objectives like "increasing access to art" or "celebrating local culture," the framework provides a pathway to connect how a digital art project meets these goals, from planning through implementation and evaluation.

Policy-level institutionalization of the framework can embed digital art into daily practice in urban planning and development, turning the efforts a core part of city-building and aligning them with social and economic objectives. It offers city governments a strategic instrument to promote cultural innovation and social cohesion in the digital era. As cities face the dilemma of how to harmonize rapid technological progress with cultural enrichment, they need systematic solutions such as our framework. They bridge vision with reality, and cities become living, open environments that are treasures of culture and creativity in the digital era.

6. CONCLUSION

This paper presents a holistic design process for digital art in cities, with the fusion of artistic innovation, technological advancements, and environmental methodology. Based on an in-depth case study in Hangzhou, we have found seven major phases, ranging from initial requirements analysis to after-installation analysis, collectively to ensure that digital art installations are intentionally designed, professionally installed, and can provide lasting social and cultural impacts. The suggested framework sufficiently fills a significant practice and theory gap by building a process model that is structured, synthesizes art and technology, and interdisciplinarity and community collaboration-oriented. By linking digital art programs to citywide goals such as cultural diversity promotion, social inclusion, and economic development, the framework aligns digital art projects with broader goals. It is an invaluable guidebook for policymakers and practitioners with step-by-step guidance on designing, implementing, and executing digital public art projects to build city life and produce public value.

The applicability of this framework is expansive. It provides artists and technologists with a strategic means to address the complexity of public art development, whereby their artistic imagination is coupled with technical expertise and user input. To city planners and cultural policy-makers, this framework is a blueprint to seamlessly integrate digital art into urban development planning, from planning to maintenance and impact assessment. Adopting this paradigm can facilitate more innovative and successful public artworks that create new avenues and expand the cultural economy. In Hangzhou, research into recent incidents that adopted this paradigm has assisted in raising points of strength and areas of weakness, providing lessons that can guide future projects within the city and beyond. In the future, when technologies continue to advance digitally, the framework should be modified to incorporate new media and tools. Future trends—AI-generated art, high-order mixed-reality, and as-yet-unknown interactive technologies—are going to pose new challenges and opportunities for public art. Future research should modify the framework to these advancements by examining how AI can be utilised in design and testing stages or how real-time data analysis can be employed to inform post-installation assessment. Cross-cultural research would also be beneficial in cross-verifying and transposing the model to other urban environments so that it becomes applicable more widely across various socio-cultural contexts. Longitudinal research on the economic and social impacts of digital art installations would enrich our knowledge base of their contribution to urban renewal and facilitate policy-making even further.

Finally, public digital art is a new area of urban creativity interlacing culture, technology, and society. In possessing an apt procedure for developing and implementing it, the cities will be able to realize the

potential of public digital art more effectively as it is, in bold conceptualizations being translated into significant experience touching masses, reflecting local visions, and assisting in sustainable futures for the cities.

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