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Integration of Design Approach and Digital Technology in Preserving Architectural Heritage in Indonesia

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A B S T R A C T

Digital design and technology are increasingly playing an important role in the preservation of cultural heritage in Indonesia, along with the ongoing digital transformation in various cultural institutions. This phenomenon presents challenges in selecting the right technology and opportunities to create more inclusive, immersive, and contextual digital experiences. The main issue raised is the absence of a systematic approach in the application of digital technology that is in accordance with the characteristics and needs of each type of heritage, such as colonial buildings, traditional buildings, and temple buildings. This study aims to examine the contribution of design approaches in developing digital solutions for conservation and evaluate the suitability of various digital technology platforms in the context of the three categories of architectural heritage. The method used is a literature study with a comparative analysis of the application of digital technology in a number of cultural heritage sites in Indonesia. The results of the study show that each category of building has different technical, narrative, and visual needs, thus requiring a specific and targeted technological approach. A design approach integrated with software engineering principles has been proven to strengthen the effectiveness of conservation and expand the reach of education and public appreciation of cultural heritage through digital media.

INTRODUCTION

The development of digital technology has brought about major transformations in various fields, including in the preservation of cultural heritage. Along with the advancement of spatial modeling software, digital documentation, and interactive platforms, conservation is no longer only understood as a physical action to maintain form and structure, but also includes efforts to reinterpret and convey heritage values to the public through digital media. This is in line with the view that cultural heritage is not just an artifact, but also a construction of meaning that must continue to be maintained and communicated across generations (Giaccardi 2012).

However, in Indonesia, digital transformation in cultural preservation has not been carried out evenly. There are still gaps in the application of technology, both in terms of infrastructure, human resources, and targeted design approaches. Many digitalization efforts only focus on the documentary aspect, without considering the potential for immersive and interpretive experiences that can be produced through a more holistic design approach. This challenge is increasingly complex considering the diversity of typologies and values of heritage architecture in Indonesia which require different conservation strategies.

The Phenomenon of Cultural Heritage Preservation in Indonesia Indonesia has an extraordinary wealth of cultural heritage, ranging from ancient temples that represent the spiritual and historical values of the glory of past civilizations, colonial buildings that are silent witnesses to colonization and the transition to modernity, to traditional houses that are full of local wisdom and social structures. All three - temples, colonial buildings, and traditional houses - represent architectural heritage that differ in terms of form, historical context, and cultural value.

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Efforts to preserve all three have been carried out in various forms, both through government regulations such as Law Number 11 of 2010 concerning Cultural Heritage, and through digital initiatives such as the digitalization of Borobudur by the Borobudur Conservation Center and the 3D model of the Old City area by the digital cultural heritage community. However, these approaches have not fully utilized the potential of interactive design and immersive technology that can increase public access and involvement more widely.

Contextual cases of architectural heritage

The three categories of architectural heritage that are the focus of this research - colonial buildings, traditional buildings, and temple buildings - represent the complexity and diversity of challenges in digital conservation efforts. Colonial buildings, such as Lawang Sewu in Semarang (Choirul Amin and Adi Sasmito 2023) and Gedung Kesenian Jakarta (Rachmayanti 2010), generally face the problem of reinterpreting historical values and the need to adapt spatial functions to the current context. Traditional buildings, such as Rumah Gadang in West Sumatra (RINI, NUMAN, and IDHAM 2021) and Rumah Joglo in Yogyakarta (Sumardiyanto, Antariksa, and Salura 2016), require special attention to the communal, symbolic, and local wisdom values contained in their architectural forms and spatial layouts. Meanwhile, temple buildings, such as Borobudur, and Prambanan, emphasize the importance of high precision in digital documentation due to the complexity of their forms and materials, while also requiring an approach that is sensitive to the spiritual and archaeological values, they contain (Suwardhi et al. 2016). The three categories of buildings have very different characteristics - both historically, typologically, and in terms of the values they contain - so a uniform and generic technological approach alone is not enough. Instead, an integration of digital technology with a contextual design approach that is adaptive to the needs of each type of heritage is needed (Liu, Zhang, and Osmani 2023). This is important so that digital conservation is not only a technical process, but is also able to maintain and convey the meaning of heritage in its entirety to todays and future society (Prasad, Sehgal, and Ghiya 2024).

Based on the background that has been described, this study is designed to answer two main questions. First, how can a design approach contribute effectively and contextually in supporting the digital conservation of architectural heritage in Indonesia. Second, how do the differences in characteristics between colonial, traditional, and temple buildings affect the selection and effectiveness of digital technology platforms used in conservation efforts.

In line with the formulation of the problem, the purpose of this study is to examine the role and contribution of the design approach in developing digital solutions that can support the preservation of architectural cultural heritage in a more meaningful way. In addition, this study also aims to analyze the effectiveness of various digital technology platforms based on the differences in characteristics in three categories of architectural heritage, namely colonial buildings, traditional buildings, and temple buildings. Thus, this study is expected to offer a framework of thought that can be used as a reference in the application of digital technology in a more focused, contextual, and sensitive manner to the values contained in each type of cultural heritage in Indonesia.

Literature study

Architectural heritage conservation

Architectural heritage conservation is a systematic effort to protect, maintain, and pass on historical, cultural, and symbolic values contained in a building or built environment. According to (Australia ICOMOS 2013), architectural conservation includes various activities such as preservation, restoration, reconstruction, and adaptation, with the principle that every intervention must respect the integrity and authenticity of the heritage(Australia ICOMOS 2013).

In Indonesia, conservation has become part of the national cultural policy, as stated in Law No. 11 of 2010 concerning Cultural Heritage (Nurbaiti 2020). However, the dominant conservation approach is still physical and conventional. In the context of increasingly digital change, architectural conservation requires not only the preservation of materials, but also the preservation of meaning and experiences that can be accessed across generations and geographies.

Design as an approach to digital conservation

Design plays an important role in bridging the technical and cultural aspects of digital conservation. Design approaches - whether in the form of visual design, interaction design, or user experience design - are able to bring back heritage values through attractive, informative, and easily accessible digital media. (Giaccardi 2012) asserts that design does not only function as an aesthetic device, but also as a participatory and narrative medium for cultural interpretation (Giaccardi 2012). In the context of conservation, design can help rearticulate the historical narrative, spatial structure, and symbolic elements of a cultural site. This is particularly relevant in the development of digital platforms such as virtual tours, augmented reality, and location-based educational applications, where user experience is a key element in ensuring public engagement (Mandelli et al. 2017). Thus, the design approach needs to be positioned not as a complement to technology, but as a primary strategy in inclusive and contextual digital conservation.

Digital technology in cultural heritage conservation

The advancement of digital technology has expanded the scope of architectural conservation methods. Various technologies such as building information modeling (BIM) for cultural heritage or HBIM (Means 2017), 3D laser scanning, photogrammetry, augmented reality (AR), and virtual reality (VR) have been used in the documentation, analysis, and re-presentation of historical buildings (Nguyen et al. 2023). These technologies enable virtual reconstruction of damaged or lost objects or sites, accelerate the restoration process, and expand public access to cultural heritage interactively.

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However, the application of these technologies needs to be adjusted to the context and character of each cultural heritage site. Technology that is suitable for a temple with complex relief details is not necessarily suitable for a traditional house that emphasizes cultural narratives and social relationships. Therefore, it is important to choose technology based on conservation needs and the type of cultural heritage in question.

Digital conservation studies in Indonesia and globally

In Indonesia, several digital conservation initiatives have been carried out, such as the Borobudur and Prambanan digitalization project through 3D scanning by the Borobudur Conservation Center in collaboration with international institutions (Pan et al. 2020). The digitalization of the Old City area of Jakarta has also been carried out by the digital heritage community and the DKI Jakarta government through GIS-based 3D models. The historical tourist attraction Lawang Sewu in Semarang City is featured as a visual object displayed using AR technology (Wibisono and Indriari Wardhani 2020). Meanwhile, the development of AR-based virtual tours to introduce Minangkabau traditional houses has also begun to be tested in the context of cultural education (Fadli Yusuf and Rio Akbar 2022).

Studies from abroad can be relevant comparisons, such as the SCAN Pyramids project in Egypt, the digital conservation of Pompeii in Italy, and the preservation of Kyoto temples through VR modeling in Japan. These studies show that the success of digital conservation is highly dependent on the synergy between sophisticated documentation methods, strong design narratives, and targeted information delivery strategies (Bosco et al. 2019). Although the technology is available, the main challenge lies in the integration of the approach - namely how to unite technical accuracy, cultural context, and humanistic and communicative design.

Various digital technologies in cultural heritage conservation

A variety of digital technologies are now being used to support cultural heritage conservation, both in documentation, restoration, and information dissemination. 3D laser scanning enables the creation of highly accurate digital models of historic buildings, while digital photogrammetry uses photographs to create 3D models at a lower cost. Heritage Building Information Modeling (HBIM) integrates spatial and non-spatial data for asset management and conservation planning of historic buildings (Nguyen et al., 2023). Augmented Reality (AR) and Virtual Reality (VR) provide immersive experiences to bring cultural heritage sites to life, while Geographic Information System (GIS) enables mapping and spatial analysis of cultural heritage areas for more effective protection (Hu, Ng, and Lee 2019). Web platforms and mobile applications enable the public to access information and participate in documentation, while the Internet of Things (IoT) and digital sensors are used to monitor the physical condition of buildings in real time (Perles et al. 2018). Blockchain technology is also being explored for certification and tracking of cultural heritage ownership. The selection of the right technology must be tailored to the characteristics of cultural heritage and conservation objectives to ensure the sustainability and accessibility of cultural heritage.

METHODS

This study uses a qualitative approach with a case study method to examine the role of design approaches and digital technology in preserving architectural heritage in Indonesia. This research was conducted in several stages including case identification, data collection, technology analysis, and evaluation of the effectiveness of the design approach in the context of conservation.

The first stage is case identification, where this study focuses on three categories of architectural heritage, namely colonial buildings, traditional buildings, and temple buildings. The selected cases include Lawang Sewu in Semarang (colonial building), Joglo House in Yogyakarta (traditional building), and Borobudur Temple in Central Java (temple building). The selection of these cases is based on the diversity of characteristics of each category, which provides insight into the challenges and opportunities in applying digital technology for preservation.

In the data collection stage, this study uses a literature study to identify theories and concepts related to digital conservation, interactive design, and digital technology in preserving cultural heritage. Additional data was obtained through direct observation at the heritage site that was the object of the case study, to see the actual condition of the building and the application of digital technology that has been used. In addition, interviews were conducted with conservation experts, architects, and digital heritage practitioners to explore their views on the use of technology in cultural heritage conservation.

Next, in the digital technology analysis stage, this study assesses various technologies used in architectural heritage conservation, such as 3D laser scanning, photogrammetry, Heritage Building Information Modeling (HBIM), augmented reality (AR), virtual reality (VR), and geographic information systems (GIS). The effectiveness of each technology is evaluated based on its suitability to the characteristics of the preserved building, the conservation objectives, and its impact on public accessibility and the preservation of cultural values. A comparison of technologies is made between colonial, traditional, and temple buildings to understand the advantages and limitations of each.

In addition, a contextual design analysis is carried out, which focuses on how digital design can support the preservation of historical values, spatial experiences, and symbolism contained in cultural heritage. This study assesses the use of design in digital platforms, such as virtual tours or AR applications, which provide interactive experiences for users. The evaluation is carried out to determine the extent to which the design can integrate historical and cultural elements, and how technology

can connect the community with the values of the cultural heritage.

Finally, in the evaluation and conclusion stage, the results of the technology and design analysis are reviewed to provide recommendations regarding the application of more effective digital technology in cultural heritage conservation in Indonesia. The evaluation was conducted based on factors such as the success of technology in supporting preservation, the relevance of design in conveying cultural meaning, and its impact on conservation sustainability. Based on these findings, this study developed a framework for the application of digital technology that is more targeted and contextual according to the characteristics of each heritage site.

DISCUSSION AND RESULTS

Digital transformation in cultural heritage preservation does not only depend on technological sophistication, but also on how the technology is contextualized through a design approach that is sensitive to local values, history, and spatial experience. The three categories of architectural heritage analyzed—colonial buildings, traditional buildings (Rumah Joglo Yogyakarta), and temple buildings—offer various conservation challenges that require a deep understanding of the physical and non-physical characteristics of each heritage object.

The role of design approaches in digital conservation

Design plays an important role in reinterpreting cultural heritage through digital media. In the context of conservation, the design approach not only functions as a visualization tool, but also as a narrative and educational medium. This approach allows the creation of digital experiences that are not only informative, but also affective and participatory. For example, the renovation of the Rumah Joglo through VR media not only presents its architectural form, but also revives the philosophical and symbolic values inherent in the structure and spatial orientation of the building, such as the concept of the cosmological axis and spatial layout that reflects the Javanese social hierarchy.

In the case study of colonial buildings such as Lawang Sewu, the design approach plays a role in recontextualizing the previously colonial-oriented historical narrative into a more inclusive narrative. The digitization of the building's interior and exterior with 3D models and interactive animations has succeeded in opening up new possibilities to present historical experiences without covering up the controversial past, but instead inviting users to reflect on values that have changed over time. Meanwhile, in temple buildings such as Borobudur or Prambanan, digital design serves as a bridge between spiritual experience and archaeological understanding. 3D visualization and AR-based digital simulations have been used to show how the temple structure evolved and how the relationship between space, relief, and spiritual meaning can be communicated deeply to the public. The design here not only represents the form, but also conveys the rites and rhythms of the pilgrimage process inherent in the temple site.

Heritage Characteristics and Implications for Technology Choices

The differences in physical characteristics and cultural values of the three heritage categories influence the types and approaches of digital technologies used. Colonial buildings, which are generally made of brick and wood with symmetrical structures, tend to be easier to document using 3D laser scanning and HBIM, and are suitable for restoration approaches based on structural documentation. However, the challenge lies in reinterpreting complex and often controversial historical narratives.

Traditional buildings such as the Rumah Joglo present different challenges. Their communal values, spatial philosophies, and wood-based construction techniques that are strongly influenced by cultural contexts require documentation that captures not only their form, but also how the form is used and interacts with the community. Therefore, a combination of photogrammetry technology, cultural value-based HBIM, and interactive narrative design becomes more relevant.

In contrast, temple buildings, which are archaeological monuments, require a high level of precision in spatial documentation, making 3D laser scanning and aerial photogrammetry the primary choices. However, to be more educational and engaging for the public, design approaches such as animated digital reconstruction, location-based AR applications, and visual historical storytelling in multimedia platforms are needed to revive its spiritual and historical context.

Evaluation of the effectiveness of digital approaches

Evaluation of the implementation of digital technology in the three categories shows that the effectiveness of conservation depends not only on the type of technology, but also on the fit between the technology and the heritage context, as well as the quality of the design in conveying cultural meaning. Digital platforms that successfully combine technical information, cultural narratives, and user participation tend to be more effective in increasing public awareness and engagement in heritage preservation.

At Lawang Sewu, the use of interactive virtual tours with time-based historical narratives has been shown to expand public access to historical information without limiting it to physical visits. At Rumah Joglo, digital reconstruction based on ethnographic studies allows for a deeper understanding of the philosophy of space and traditional Javanese social structure. Meanwhile, at temples such as Borobudur and Prambanan, the integration of spatial data and spiritual narratives in digital media allows for a pilgrimage experience that is both contemplative and informative.

However, challenges remain, such as limited human resources who master technology, lack of data interoperability standards between platforms, and unequal awareness of the importance of a design approach in digital conservation. This shows that the success of digital conservation depends not only on

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technological sophistication, but also on an integrated framework between cultural actors, designers, technologists, and the community.

Research results

This study reveals that the design approach plays an important role in supporting more effective and contextual digital conservation of architectural heritage in Indonesia. By linking these results to the first problem statement, namely how the design approach can support digital conservation more effectively and contextually, it was found that:

- Design as narrative and cultural mediation: Design that is sensitive to local values can transform digital conservation from mere technical documentation to interpretive and educational media. Digital experiences designed with attention to symbolic meaning and spiritual values have been shown to increase public engagement and understanding of cultural heritage, as seen in the cases of Rumah Joglo Yogyakarta and Borobudur Temple.
- Contextualization of the digital approach: A design approach that is adaptive to cultural and historical contexts allows digital technologies (such as VR, AR, and HBIM) to be used more appropriately and meaningfully. This shows that the success of digital conservation is not only about data accuracy, but also the extent to which digital design can represent invisible values.

For the second problem statement, namely how the differences in characteristics between colonial, traditional, and temple buildings affect the selection and effectiveness of digital technology, the results of the study show that:

- Physical characteristics and cultural values determine the selection of technology: Colonial buildings tend to be suitable for structural documentation approaches (laser scanning and HBIM), while traditional buildings such as the Rumah Joglo in Yogyakarta require a more narrative and participatory ethnographic approach, as well as integration with interactive media. Temples as archaeological heritage requires high spatial precision, but are also revived through AR/VR-based spiritual visualization.
- Uniform digital technology is ineffective: The uniform application of digital technology to all categories of heritage has been shown to obscure the uniqueness of each type of heritage. Therefore, the selection of digital platforms and methods must consider the intrinsic value of each object, both tangible and intangible.

Thus, the results of this study show that the design approach makes a significant contribution to the development of digital solutions for the preservation of cultural heritage, because it is able to bridge the needs of technical documentation and the delivery of cultural values inherent in cultural heritage objects. The effectiveness of the application of digital technology in conservation is highly dependent on its contextuality, not solely on the level of sophistication of the technology itself. The most successful digital platforms are those that are able to accommodate the unique characteristics of each category of architectural heritage, whether colonial, traditional, or temple, and align the form of digital presentation with the cultural values they contain. Therefore, a digital conservation framework is needed that is based on a design approach and sensitivity to context, so that the adoption of technology is not only technically efficient, but also culturally relevant and inclusive in building social engagement.

CONCLUSION

This study confirms that the success of digital conservation of architectural heritage is not only determined by the sophistication of technology, but also depends on the extent to which the design approach is able to interpret and communicate the cultural values inherent in the heritage object. The design approach acts as a link between the technical aspects of documentation and the narrative aspects that provide meaning, thus becoming the key to creating a contextual, inclusive, and meaningful digital experience.

The three categories of architectural heritage studied - colonial buildings, traditional (Rumah Joglo), and temples - show that each type has different conservation needs and challenges. Colonial buildings require historical reinterpretation and narrative adaptation, traditional buildings require an understanding of philosophical and social values, while temple buildings require high accuracy and spiritual meaning. This confirms that a uniform digital technology approach can actually reduce the uniqueness and meaning of each heritage object.

The implication of this finding is the importance of formulating a digital conservation framework based on design and contextuality, which can guide the selection of technology, presentation strategies, and forms of public engagement that are in accordance with the character of the heritage. This framework needs to involve interdisciplinary collaboration - between architects, designers, archaeologists, IT experts, and local communities—to ensure that digital conservation is not only technocratic, but also participatory and sustainable. In addition, policies and institutional support are needed to encourage the integration of digital technology in cultural conservation, including the development of human resource capacity, the development of data interoperability standards, and the creation of a collaborative ecosystem between preservation institutions, education, and the creative industry. In the future, digital conservation will not only be a documentation tool, but also a medium for education, cultural diplomacy, and the development of collective identities relevant to the digital era.

REFERENCES

Australia ICOMOS. 2013. “The Burra Charter: The Australia ICOMOS Charter for Places of Cultural Significance.” International Council on Monuments and Sites. 2013.

Bosco, A., A. D’Andrea, M. Nuzzolo, and P. Zanfagna. 2019. “A BIM APPROACH FOR THE ANALYSIS OF AN ARCHAEOLOGICAL

MONUMENT." *The International Archives of the Photogrammetry, Remote Sensing and Spatial Information Sciences* XLII-2/W9 (January):165–72. https://doi.org/10.5194/isprs-archives-XLII-2-W9-165-2019.

Choirul Amin, and Adi Sasmito. 2023. "Aspek Signifikan Langgam Kolonial Pada Bangunan Lawang Sewu di Kota Semarang." *SARGA: Journal of Architecture and Urbanism* 17 (1): 64–71. https://doi.org/10.56444/sarga.v17i1.413.

Fadli Yusuf, Muhammad, and Muhammad Rio Akbar. 2022. "Perancangan Media Informasi Motif Dasar Ukiran Istana Pagaruyuang Dalam Bentuk Augmented Reality." *Judikatif: Jurnal Desain Komunikasi Kreatif*, June, 38–43. https://doi.org/10.35134/judikatif.v4i1.51.

Giaccardi, Elisa, ed. 2012. *Heritage and Social Media*. Routledge. https://doi.org/10.4324/9780203112984.

Hu, Xiao, Jeremy Ng, and Jin Ha Lee. 2019. "VR Creation Experience in Cultural Heritage Education: A Preliminary Exploration." *Proceedings of the Association for Information Science and Technology* 56 (1): 422–26. https://doi.org/10.1002/pra2.42.

Liu, Zhen, Man Zhang, and Mohamed Osmani. 2023. "Building Information Modelling (BIM) Driven Sustainable Cultural Heritage Tourism." *Buildings* 13 (8): 1925. https://doi.org/10.3390/buildings13081925.

Mandelli, A., C. Achille, C. Tommasi, and F. Fassi. 2017. "INTEGRATION OF 3D MODELS AND DIAGNOSTIC ANALYSES THROUGH A CONSERVATION-ORIENTED INFORMATION SYSTEM." *The International Archives of the Photogrammetry, Remote Sensing and Spatial Information Sciences* XLII-2/W5 (August):497–504. https://doi.org/10.5194/isprs-archives-XLII-2-W5-497-2017.

Means, Bernard K. 2017. "3D Recording, Documentation and Management of Cultural Heritage." *Historical Archaeology* 51 (4): 582–83. https://doi.org/10.1007/s41636-017-0055-x.

Nguyen, Thu Anh, Sy Tien Do, Truong-A Pham, Dai Huu Nguyen, and Hiroshi Tamura. 2023. "Integration of H-BIM, Virtual Reality, and Augmented Reality in Digital Twin Era - A Case Study in Cultural Heritage." In, 303–12. https://doi.org/10.1007/978-981-19-3303-5_24.

Nurbaiti, Siti. 2020. "PENGATURAN PERLINDUNGAN BANGUNAN CAGAR BUDAYA PADA MASA PERANG DALAM UU NO.11 TAHUN 2010 TENTANG CAGAR BUDAYA." *TerAs Law Review: Jurnal Hukum Humaniter Dan HAM* 2 (1): 165–78. https://doi.org/10.25105/teras-lrev.v1i2.7112.

Pan, J., L. Li, H. Yamaguchi, K. Hasegawa, F. I. Thufail, and S. Tanaka. 2020. "FUSED 3D TRANSPARENT VISUALIZATION FOR LARGE-SCALE CULTURAL HERITAGE USING DEEP LEARNING-BASED MONOCULAR RECONSTRUCTION." *ISPRS Annals of the Photogrammetry, Remote Sensing and Spatial Information Sciences* V-2–2020 (August):989–96. https://doi.org/10.5194/isprs-annals-V-2-2020-989-2020.

Perles, Angel, Eva Pérez-Marín, Ricardo Mercado, J. Damian Segrelles, Ignacio Blanquer, Manuel Zarzo, and Fernando J. Garcia-Diego. 2018. "An Energy-Efficient Internet of Things (IoT) Architecture for Preventive Conservation of Cultural Heritage." *Future Generation Computer Systems* 81 (April):566–81. https://doi.org/10.1016/j.future.2017.06.030.

Prasad, Tanishq, Aman Sehgal, and Saksham Ghiya. 2024. "A Study on Cultural Heritage Preservation in the Digital Era." *INTERANTIONAL JOURNAL OF SCIENTIFIC RESEARCH IN ENGINEERING AND MANAGEMENT* 08 (02): 1–13. https://doi.org/10.55041/IJSREM28803.

Rachmayanti, Sri. 2010. "Perjalanan Sejarah Gedung Kesenian Jakarta." *Humaniora* 1 (2): 501. https://doi.org/10.21512/humaniora.v1i2.2891.

RINI, Johanita Anggia RINI, İbrahim NUMAN, and Noor Cholis IDHAM. 2021. "Structural Performance and Constructional Phases of Rumah Gadang of West Sumatra, Indonesia." *Bāb Journal of Architecture and Design* 2 (1).

Sumardiyanto, Sumardiyanto, Antariksa Antariksa, and Purnama Salura. 2016. "MAKNA RUANG PUBLIK PADA RUMAH TRADISIONAL MASYARAKAT JAWA KASUS STUDI: DESA JAGALAN KOTAGEDE YOGYAKARTA." *NALARs* 15 (1): 1. https://doi.org/10.24853/nalars.15.1.1-12.

Suwardhi, Deni, Muhammad Mukhlisin, Dendy Darmawan, Shafarina Wahyu Trisyanti, Brahmantara Brahmantara, and Yudi Suhartono. 2016. "Survey Dan Pemodelan 3D (Tiga Dimensi) Untuk Dokumentasi Digital Candi Borobudur." *Jurnal Konservasi Cagar Budaya* 10 (2): 10–22. https://doi.org/10.33374/jurnalkonservasicagarbudaya.v10i2.150.

Wibisono, Arif, and Theodora Indriari Wardhani. 2020. "DESAIN VIRTUAL TOUR BANGUNAN BERSEJARAH LAWANG SEWU SEMARANG MENGGUNAKAN APLIKASI AUGMENTED REALITY BERBASIS WEB (WEBAR)." *Jurnal Ilmiah Teknosains* 6 (2/Nov): 39–50. https://doi.org/10.26877/jitek.v6i2/Nov.7100.