Elevating cultural understanding: interactive museum exploration using 3D AR and MDLC framework

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ABSTRACT

Limited access to information and interaction with artifacts in museums often hinders visitors from gaining a deeper understanding of the culture and historical context presented. This study addresses this challenge by developing a three-dimensional (3D) augmented reality (AR)-based interactive museum that enhances the museum visitor experience through an intuitive user interface (UI) and enriched content related to the exhibited artifacts. This study explores the potential of 3D AR technology in enhancing visitor engagement and interaction with museum exhibits, providing a more immersive and informative experience. This study uses the multimedia development life cycle (MDLC) as a framework to develop a 3D AR-based interactive museum. By applying the MDLC approach, this study integrates advanced AR technology with comprehensive and detailed content, resulting in a structured and user-centered interactive platform. Key benefits of this approach include enhanced interactivity, enriched artifact information, and an intuitive interface that facilitates easier access to museum content. The findings indicate that the developed interactive museum successfully overcomes the barriers of limited accessibility of information and interaction with artifacts. Through the application of advanced AR technology, the museum visitor experience is significantly enhanced, making the museum more inclusive, interactive, and educative for visitors.

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1. INTRODUCTION

Museums play a vital role in preserving culture and history, providing a place to understand a nation's heritage. However, the traditional museum experience is often limited, especially in terms of accessibility of information and interaction with artifacts. Visitors are often only able to view artifacts protected by glass cases or other protective barriers, which limits in-depth understanding of the objects. This poses a major challenge in creating a more immersive and meaningful museum experience. Augmented reality (AR) technology offers an innovative solution that can overcome these barriers. AR allows visitors to interact with artifacts in a more immersive way, providing a more informative and comprehensive experience. This research aims to develop an interactive museum based on three-dimensional (3D) AR that can enrich the visitor experience through more advanced technology and access to more in-depth information about the artifacts on display.

In addition to providing innovative technological solutions, this research also aims to integrate these solutions with in-depth and informative content related to the artifacts exhibited in museums. The multimedia development life cycle (MDLC) approach used in this research will not only assist in technology development but also ensure that the presented content meets user needs and supports deeper cultural understanding. Previous research has shown that the use of the MDLC method is more commonly applied to learning applications [1]-[5] interactive animation and 3D animation [6]-[8], videos [9]-[11], and educational games [12]-[14], while museums have not widely adopted it yet. In other research, the MDLC method is also used for the development of AR for learning media [15]-[17], web-based applications [18], [19], interactive learning media via mobile devices [20], [21]. Thus far, analysis has only found the use of MDLC in creating 3D objects for museums [1], [22], but it is limited to museum introduction only. Therefore, this study uses the MDLC framework, which has proven effective in developing multimedia applications in various fields. Although MDLC has been widely applied in the development of learning applications, interactive animations, and other educational media, its use in the museum context is still limited. Therefore, this study focuses on the application of MDLC to develop a 3D AR-based museum website that will integrate technology with informative content that is easily accessible to visitors.

There are several contributions to this research, including:

- Enhanced visitor experience: by introducing web-based 3D AR technology, this research will make a significant contribution to enhancing the museum visitor experience. Visitors will be able to explore artifacts in detailed 3D formats and gain richer information about the history, cultural context, and other related aspects.
- Enrichment of artifact information: through the integration of informatively and intuitively presented content, this research will contribute to enriching the available information about the artifacts exhibited in the museum. Visitors will gain access to deeper and more comprehensive information, which can enhance their understanding and appreciation of the museum's collections.
- Innovation in education and learning media: by introducing a more interactive and technology-based approach, this research will inspire other museum institutions to adopt web-based 3D AR technology as a means of conveying knowledge and enhancing visitor learning experiences.
- Development of technological skills: this research will also contribute to the development of technology skills for developers and professionals in the multimedia and AR fields. The process of developing and implementing AR technology will involve various technical skills, which can enhance the competence and capabilities of practitioners in leveraging the latest technology for educational and cultural purposes.

Thus, this research will not only provide concrete solutions to the existing gaps in museum visitor experiences but also contribute more broadly to the development of new approaches in education and culture, as well as the advancement of technological skills for professionals in related fields.

In understanding the concept of implementing AR in the context of cultural heritage, several previous studies have provided a strong foundation. For example, research by Ahmad made initial efforts to introduce museums through AR technology [1]. They explored the use of AR in the context of museum objects, providing valuable insights into the potential application of this technology in enhancing visitor interaction with museum collections. However, their research was limited to introducing museums using AR codes without utilizing other interactive media, and the MDLC method they used to be a widely used one. In this regard, MDLC has been the focus of research in the context of developing enhanced museum experiences. This can be applied to various technology-based projects, optimizing the development process to achieve more effective and comprehensive results. Several studies also explore the application of various technologies in the contexts of education, psychology, and culture. Research by Kumala *et al.* [3], Woda *et al.* [5], and Putri *et al.* [21] applies the MDLC method in building multimedia-based learning systems to enhance student interaction in learning. Additionally, Ivan *et al.* [2], Kumala *et al.* [3], also applied MDLC to build educational applications to increase student interest in learning. These studies provide an important foundation for using MDLC for the development of multimedia content focused on education. In a different field, Rahayu *et al.* [13] applied the MDLC method in gamification, building educational games with an MDLC approach. In the realm of videography, there are studies using the MDLC approach to develop animated videos [6], [7], and 3D animations as effective methods for learning and educating psychology. Wibowo and Lisanto [10] applied MDLC to create cinematic videos applied to blog sequences using the MDLC approach. Similarly, Sitompul [9] also applied the same method to build infographic videos in a village.

Furthermore, AR technology has experienced rapid advancements and is increasingly integrated into various aspects of life. AR enables users to view the real world with added digital elements, such as images, videos, or additional information, displayed through devices like smartphones, tablets, or smart glasses. Recent innovations in AR include improvements in object detection and tracking, more precise environmental mapping, and the development of user-friendly AR platforms.

In related research literature, Solehatin *et al.* [16] developed AR to facilitate interactive learning. The results of this study show great potential in enhancing understanding through interactive exploration using AR technology. In the context of museums, Ahmad *et al.* [1] used AR technology to introduce museums using the

MDLC approach, with results showing that 83% of respondents agreed that the developed AR application was acceptable to the public. There are still various studies related to the development of AR for museums, but the approaches used and the research contexts are quite varied. For example, Lee *et al*. [22] developed online and offline AR learning tools related to museum artifacts using the integrated learning model but limited it to third and fourth-grade elementary school students to stimulate their interest and engagement in learning history and culture. Chen and Lai [23] tested the effectiveness of using AR in museums and analysed related theories and empirical evidence, with their research findings indicating a positive relationship between visitor acceptance, AR usage in museums, and increased student learning motivation. Khan *et al*. [24] proposed a smartphone-based AR application that uses real-time deep learning to recognize artifacts and provide supporting multimedia information to visitors. The results showed that the accuracy of artifact recognition was much better than traditional museum tours. However, the research focuses more on textual artifact information rather than visual.

Related studies in the development of AR-based learning media for museums have shown an increased interest in utilizing the latest technology to enhance visitor experiences. As a continuation of previous research, this study emphasizes the development of a 3D AR-based website specifically for museums to enhance visitor experiences and enrich artifact information. Gap analysis in this research highlights the need for innovative approaches in presenting informative and interactive multimedia content. With a focus on developing technological skills, this research also contributes to enhancing the competence of multimedia and AR practitioners in leveraging the latest technology. Other related studies indicate that the use of AR technology in the museum context is still very limited, so this research is expected to fill existing knowledge gaps. By designing an intuitive and easy-to-navigate user interface (UI), the 3D AR website developed in this study is expected to provide visitors with a deeper and more memorable experience. Thus, this research not only contributes to the development of AR technology for museums but also to the development of new approaches in education and culture.

2. METHOD

This study employs the MDLC methodology, which follows a series of stages including product analysis, development, and launch. While sharing similarities with the software development life cycle (SDLC), MDLC has distinct features tailored to the creation and utilization of multimedia components. MDLC model it is formulated through 5 stages as illustrated in Figure 1.

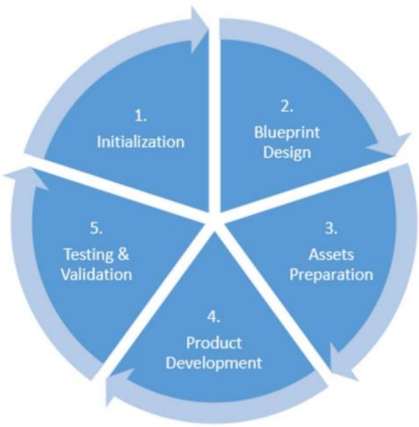

Figure 1. MDLC method

Typically, MDLC is applied in constructing multimedia products, whether linear or non-linear in nature. This research compared various types of MDLC from several researchers [25], each of which has its strengths and weaknesses. Luther's model stands out in the material collection and assembly stages, accelerating the development of multimedia products. however, it lacks emphasis on the interactivity of non-linear products. Conversely, Godfrey's MDLC overly emphasizes non-linear products. Vaughan, Villamil-Molina, and Sheerwod-Rout are rooted in SDLC, but there is variation in the use of multimedia elements. Thus, this research propose a revised MDLC approach method to be used. The MDLC method in the research is chosen because the product developed in this research is a non-linear multimedia, in the form of an AR-based website.

2.1. Initialization stage

This phase marks the beginning of defining the structure of the multimedia product under development. The outcome here is a preliminary document outlining the product requirements, team composition, project timeline, and budget. Given that the research aims to yield a non-linear multimedia product, this phase will also outline the diverse features to be incorporated and the technological specifications for website development.

2.2. Blueprint design stage

At this stage, a technical document is prepared to serve as the primary guideline for the entire website development process. The document outlines the system requirements, technical specifications, and development standards to ensure a structured and consistent workflow. In addition, a storyboard is created to illustrate the website's navigation flow, page layout, and UI elements. The storyboard not only provides a visual representation of the intended design but also functions as an initial validation tool to confirm alignment with user needs and project objectives before entering the production phase. Thus, this stage plays a crucial role in bridging conceptual planning and technical implementation.

2.3. Assets preparation stage

The assets preparation phase involves preparing a variety of multimedia assets for use in the production process. The outcome of this phase is a centralized library comprising classified multimedia assets, each standalone and ready for integration with other elements. In this stage, libraries of UI elements will be generated to be used in executing the functions of each icon/button on the website. AR codes for 3D artifacts and various information needed in the AR website being developed will also be prepared in this stage.

2.4. Product development stage

The outcome of this stage is a multimedia product, which in the context of this research takes the form of an AR-based museum website. At this stage, the development process focuses on producing the UI of the website pages that are seamlessly integrated into the main application. The UI design not only determines the visual appearance and layout of the web pages but also ensures that the interaction flow supports usability, accessibility, and overall user experience. Furthermore, the integration of the UI with the main application is carried out to guarantee functional coherence, so that the AR features and website components operate as a unified system. This stage therefore plays a critical role in transforming design specifications into a tangible digital product that can be tested, validated, and further refined.

2.5. Testing and validation stage

This stage is the testing and validation stage of the multimedia product. In this stage, validation is conducted using initial data from the initialization phase. If any features are found to be inconsistent with the initial design, they are reproduced to enhance the features as needed. However, if all features are consistent and function well during testing, the application will be accepted and validated.

3. RESULTS AND DISCUSSION

3.1. Result of the initialization stage

Several features of the AR-based museum website developed in this study are presented in Table 1 as a reference for understanding the system's capabilities. These features highlight both the functional and interactive aspects that support the delivery of museum content through ARF technology. To realize these features, the development process incorporates multiple supporting technologies. Among them, AR Code is utilized to generate and manage AR markers that serve as the entry point for AR experiences, while 3D modeling software is employed to design, construct, and optimize 3D digital objects displayed within the system. The integration of these technologies ensures that the website not only provides informational content but also offers an engaging and immersive user experience, aligning with the objectives of this research.

3.1. AR code

AR code is a special code used in AR technology to provide interactive experiences to users. In this research, AR code is used as a key to unlock AR content related to artifacts so that they can be viewed in detail with a 3D form similar to the original. The AR codes used on the website, are created using AR code for smartphones with the Android operating system and ARKit for creating AR codes used on smartphones with the iOS operating system.

Table 1. Features available on the AR-based museum website

Features	Description
AR display	Users can experience virtual exhibitions added to the physical environment around them by scanning AR codes using their smartphone cameras.
Interactive artifacts	Users can interact with 3D artifact models, rotate artifacts up to 360° to view details, zoom in or out on artifacts, and access additional information. This is also done by scanning AR codes from the user's smartphone camera.
Information panel of artifacts	It contains descriptions, historical context, and educational information provided alongside artifacts to enhance users' understanding of the artifacts in the museum.
Artifact's pop-up name	Pop-ups can be found in the corner of the screen when a 3D artifact is displayed, and if clicked, information about the artifact's name and year will appear.
Social sharing	In this feature, users can share the provided content on the web to share their experiences through their social media platforms. This can be integrated with platforms such as WhatsApp, Instagram, and Facebook.
Search option	Users can search for artifacts by entering the artifact name or year in the search column.
Feedback anonymous	In this feature, users can also provide constructive feedback or input to developers without having to enter their data, thus ensuring their privacy remains secure.

3.2. 3D software

3D artifacts are digital representations of real-life objects in 3D form. In this research, the objects being digitally modeled are historical artifacts, characters, and cultural artifacts replicated in a 3D space. To create these 3D artifacts, Blender software is used. Blender is an open-source software for creating 3D models, rendering, animation, and other 3D content creation. Blender was chosen for creating museum artifacts to be included on the AR-based website in this research because it has a user-friendly interface and comprehensive features.

3.3. The results of the blueprint design stage and the assets preparation stage

The blueprint design stage in the development of the 3D AR-based museum website has yielded a series of detailed plans and designs for the overall site architecture and functionality, as depicted in Figure 2. During this stage, various elements such as the UI, interactive features, and AR technology integration have been carefully designed to ensure an optimal user experience.

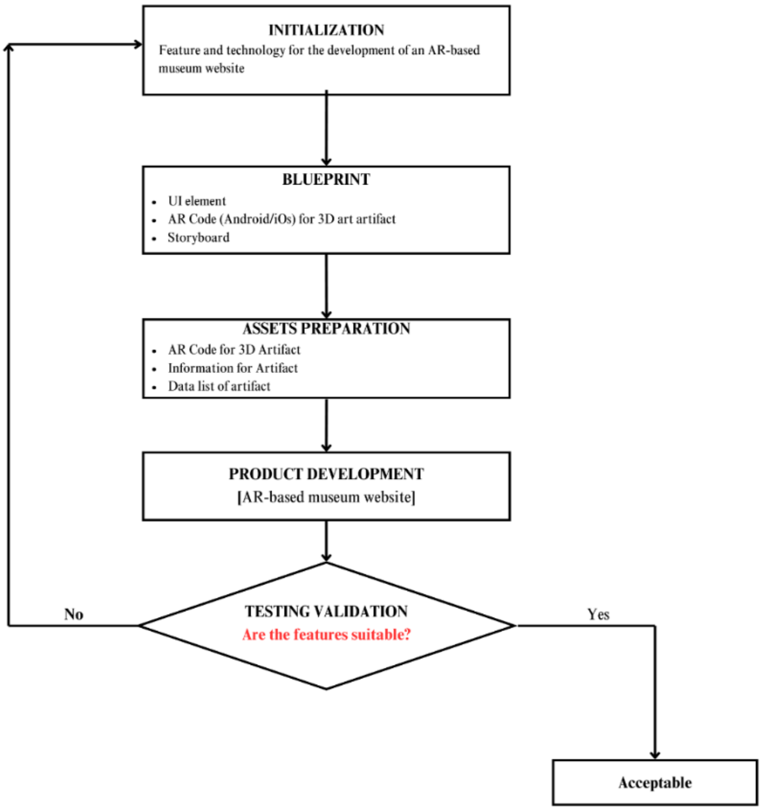

Figure 2. The stage of MDLC was carried out in this research

Furthermore, the assets preparation stage is an important process in preparing visual and multimedia content to be incorporated into the 3D AR-based museum website. In this stage, various types of materials such as 3D models, textures, images, and videos are meticulously prepared according to the established technical specifications. Collaborating closely with museum curators and content specialists to ensure that all assets meet the desired quality and consistency standards. This process also involves testing and optimizing assets to ensure optimal availability and performance when accessed through web platforms and AR technology.

The outcome of the assets preparation stage is a collection of materials ready to be used to build an immersive and informative virtual experience for site visitors. The materials collected in this stage include a list of artifacts, photos/paintings from the museum, photos of museum buildings and surroundings, AR codes prepared to be inserted on the website, and 3D artifact objects that have been rendered and are ready to be inserted into the website and linked to AR codes.

Figure 3 shows a storyboard depicting the components and features of the UI of a 3D AR-based museum website. The storyboard illustrates how visitors can interact with the website through various visual elements designed to enhance their experience.

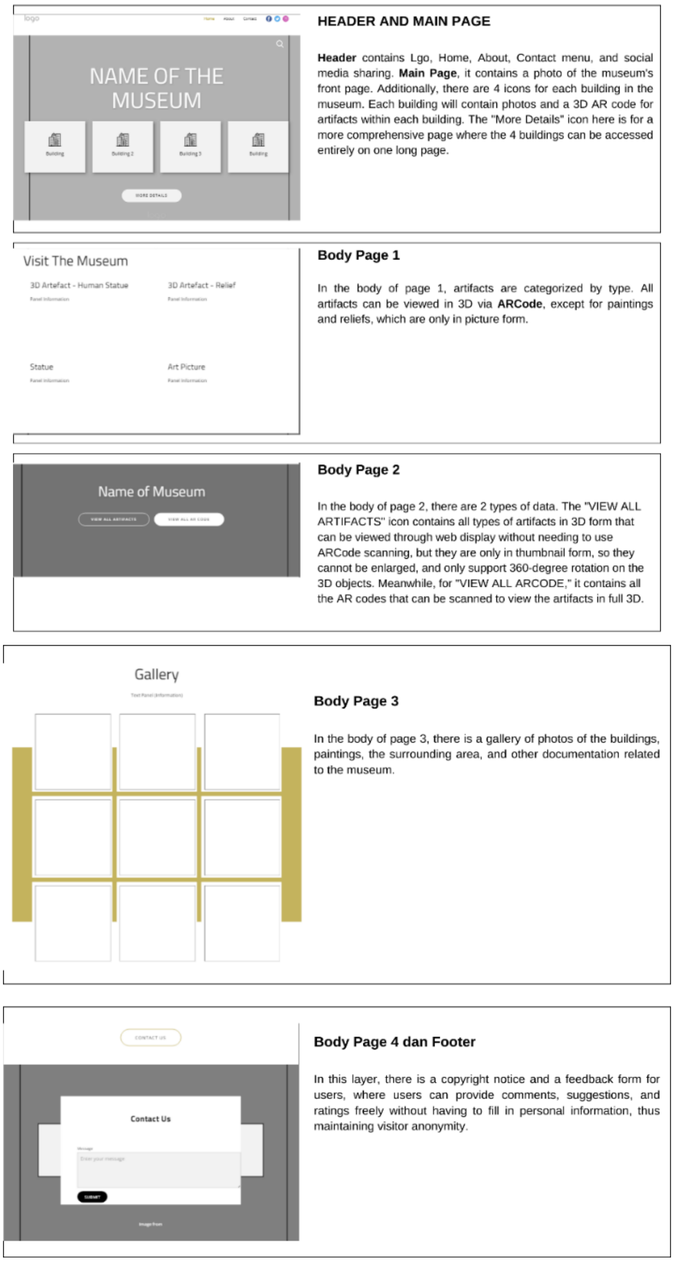

Figure 3. Storyboard of UI components and features of the 3D AR-based museum website

3.4. Result of the product development stage

The output of this stage is the multimedia product, which in this research is an AR-based museum website. In this stage, the UI of the web pages integrated into the main application is produced. The results of this stage can be seen in Figure 4. Part A is the main page that displays the museum building and facilities. Part B page 1 is a collection of artifacts based on their type. Part C page 2 displays links to 2 types of collection data, a collection of artifact images and a 3D display AR code. Part D page 3 is a collection of 3D display AR codes. Part E page 4 displays photos of the museum’s collections and facilities. Part F is a user feedback page. Part G is a footer copyright notice.

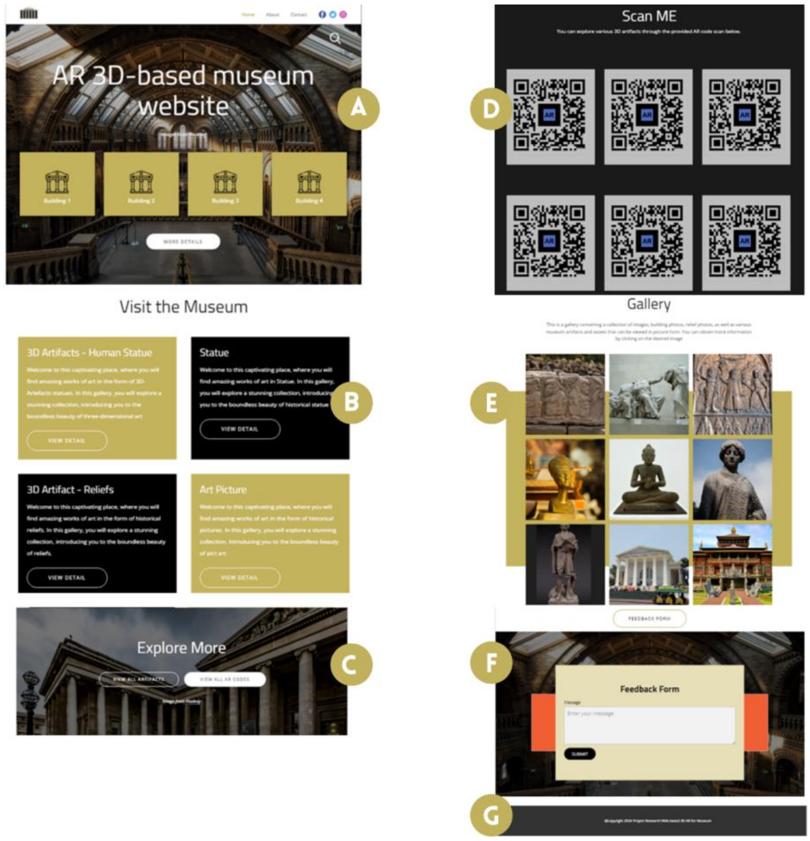

Figure 4. UI of the 3D AR-based web page integrated into the main application

Figure 5 shows a screenshot of the iOS Objects feature that allows users to view objects in highly detailed 3D from multiple perspectives. This feature is designed to enhance visitor interaction with artifacts or objects on display in museums via iOS devices.

Figure 5. View of a 3D object that can be scanned via AR code

In this image, users can view 3D objects with the ability to rotate or pan the object, providing a more immersive experience and allowing them to examine each part of the object from multiple perspectives. With AR technology, the details of the object can be seen more clearly, allowing users to explore textures, shapes, and other features that may not be visible in a regular static view. This feature gives visitors full control, allowing them to explore objects with greater immersion and understand the characteristics of the object in greater detail, whether it is an art artifact, historical object, or other object on display in the museum.

Figure 6 shows the results of scanning AR Code through a smartphone camera, where users can view objects in three different types of views, according to their needs. This feature allows visitors to access additional information about objects or artifacts scanned with AR Code directly using a smartphone device.

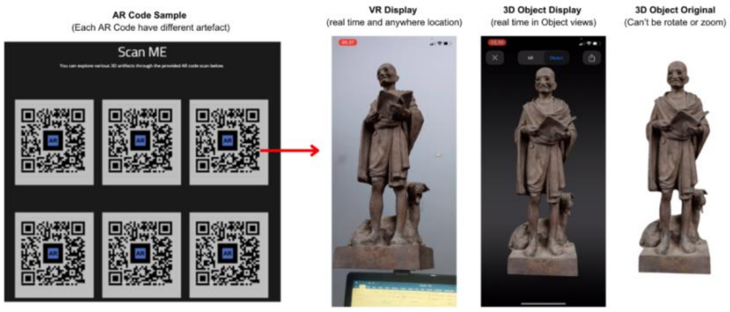

Figure 6. The results of scanning AR Code through a smartphone camera

Figure 7 shows the view on the “AR” feature so it can be seen using the original background according to real life. Image 1 (left side), shows the 3D artifact view after scanning the AR code using an iOS-based smartphone with information panels and artifact names visible. The information panel will not disappear even if the image is zoomed in or out, or rotated from various angles. Meanwhile, for the small icon below (no 2), if that icon is clicked, the page will switch to the complete main artifact information so that users can better understand the information about the artifact being viewed. In view number 3 (image on the right), there is also a small icon next to the image, if clicked, it will return to the AR display through the smartphone.

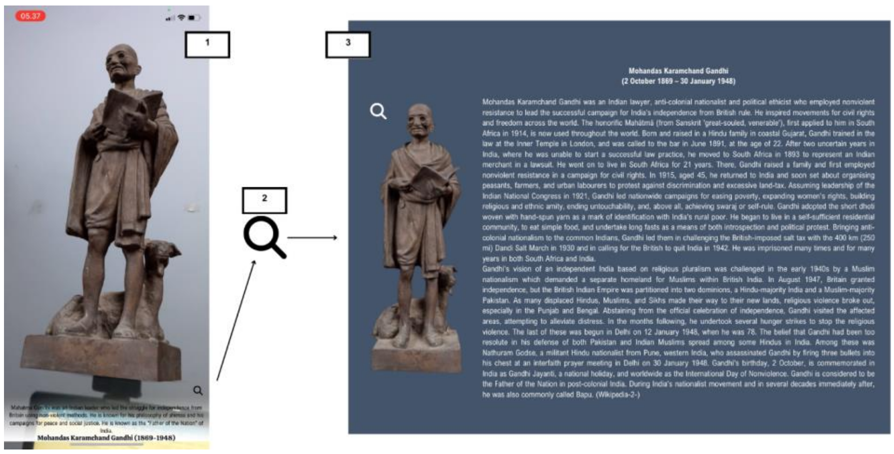

Figure 7. Display of 3D objects that can be scanned through AR codes

3.5. Result of the testing and validation stage

This stage is the testing and validation stage of the multimedia product. In this stage, validation is done using initial data from the initialization phase, if features are found that do not match the initial design, then a reproduction is carried out to improve the features as needed. To calculate the success percentage of the testing & validation stage in this research, a specific success metric is needed. In this case, the calculation metric used for the success percentage is the number of tested features, can be seen in Table 2.

Table 2. Beta testing results

Features tested	Description	Test result	Next steps
AR 3D display	Validating the ability of 3D AR to display artifacts and information in the environment.	The 3D AR feature displays artifacts clearly and some information is not cut off.	Verified
Interactive artifacts	Testing the artifact's ability to interact with users, such as zooming, rotating, or clicking.	Overall, artifacts respond well to user interactions and some interactive features work properly.	Verified
Artifacts information panel	Checking the clarity and completeness of the information panels provided for each artifact.	The provided information is sufficiently comprehensive and easily accessible.	Verified
Artifact's pop-up name	Testing pop-ups that appear when artifacts are clicked to display the artifact's name.	There is a slight delay in the artifact name pop-up when the image starts to open.	Verified
Social Sharing	Checking the ability to share information or artifacts via social media.	The social sharing feature works well, making it easy for users to share what they see on social media.	Verified
Search option	Testing the user's ability to search for specific artifacts or information.	The search option provides relevant and complete results.	Verified
Feedback anonymous	Checking the user's ability to provide anonymous feedback on their experience with the website.	The anonymous feedback feature is easily accessible and works well.	Verified
Device compatibility	Ensuring the website's performance on various devices and operating systems.	The website experiences display and performance issues on low-end Android devices.	Optimizing to improve compatibility with low-end Android devices.
Navigation	Verifying ease of navigation between exhibition spaces and artifacts.	Navigation is intuitive enough, and some users don't have trouble navigating.	Verified
Responsivity	Verifying the speed and responsiveness of the website when loading content and interacting with users.	The website responds with slightly longer wait times when loading 3D content, but its responsiveness is satisfactory.	Identifying and fixing the causes of the delay in loading 3D content.

To calculate this percentage, the following formula is used:

$$Success\ Percentage = \frac{Number\ of\ Successfully\ Tested\ Features}{Total\ Tested\ Features} \times 100\%$$

So, the obtained result is:

$$Success\ percentage = \frac{8}{10} x100\% = 80\%$$

For product and design validation, the approach taken is a black box. The results of black-box validation are presented in Table 3 (see in Appendix). The results of the black-box validation conducted show that the system meets all the requirements and specifications that have been established with perfect accuracy, thereby indicating its validity reaching 100%.

4. CONCLUSION

This study successfully developed a web-based 3D AR technology platform for museums, which significantly improved visitor accessibility and engagement. By integrating an adapted MDLC methodology, the study created an interactive and user-friendly platform that allows visitors to explore artifacts in detailed 3D while accessing richer information about their historical and cultural context. This achievement highlights the potential of AR in transforming the museum experience, offering visitors a more immersive and engaging way to interact with exhibits.

The integration of AR with the MDLC approach proved to be a key factor in ensuring a structured development process, leading to increased user engagement and a smooth learning experience. The combination of interactive 3D models and informative content not only enhanced visitors' understanding but also their appreciation of cultural heritage. Beyond its immediate impact on the museum experience, this study demonstrates the broader potential for AR-based learning tools across a range of museum types, from art galleries to science and history museums. This encourages museum institutions to adopt cutting-edge technology to enhance visitor education and engagement.

In terms of future research, it would be valuable to explore visitors' long-term engagement with AR-based museum platforms and assess how these experiences impact cultural understanding over time. Additionally, expanding AR applications to other cultural heritage sectors could extend its benefits even further. Ultimately, this research contributes to the ongoing digital transformation in museums, offering insights into how innovative technologies can reshape the way we experience and learn about our cultural heritage.

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AUTHOR CONTRIBUTIONS STATEMENT

This journal uses the Contributor Roles Taxonomy (CRediT) to recognize individual author contributions, reduce authorship disputes, and facilitate collaboration.

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Ade Iriani					✓		✓	✓	✓	✓				✓

C : **C**onceptualization
M : **M**ethodology
So : **So**ftware
Va : **Va**lidation
Fo : **Fo**rmal analysis
I : **I**nvestigation
R : **R**esources
D : **D**ata Curation
O : Writing - **O**riginal Draft
E : Writing - Review & **E**diting
Vi : **Vi**sualization
Su : **Su**pervision
P : **P**roject administration
Fu : **Fu**nding acquisition

CONFLICT OF INTEREST STATEMENT

The authors declare that they have no known financial, personal, or professional conflicts of interest that could have influenced the outcomes or interpretations of this research. Furthermore, the authors confirm that there are no non-financial competing interests, such as political, religious, or ideological affiliations, that may have affected the objectivity of this work.

DATA AVAILABILITY

The authors affirm that all data supporting the findings of this study are fully available within the article [and/or its supplementary materials]. These data include the relevant information, tables, figures, and analytical results, which can be directly accessed by readers without the need to request additional materials from the authors. This statement ensures research transparency and facilitates readers in reviewing, verifying, and utilizing the published findings.

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APPENDIX

Table 3. Black-box validation result

Testing feature	Test description	Result	Validation
AR code			
Artifact 3D AR code	Scan by smartphone (Android)	Display 3D objects of current artifacts	Valid
	Scan by smartphone (iOs)	Display 3D objects of current artifacts	Valid
Header and main page			
Icon "home"	Click home button	Display the main page of the 3D AR website	Valid
Icon "about"	Click about button	Display page of museum information	Valid
Icon "contact"	Click contact button	Display contact of the museum and developer	Valid
Facebook icon	Click Facebook icon	Linked to the user's Facebook account on a different page, or get permission to open Facebook by a smartphone application	Valid
Twitter icon	Click Twitter icon	Linked to the user's Twitter account on a different page, or get permission to open Twitter by smartphone application	Valid
Instagram icon	Click Instagram icon	Linked to the user's Instagram account on a different page, or get permission to open Instagram through a smartphone application	Valid
Search button	Click search button	Display relevant results by searching keyword	Valid

Table 3. Black-box validation result (*continued*)

Testing feature	Test description	Result	Validation
Building 1 icon	Click text or box of building 1	Display a new page containing various things and various works that exist in museum building 1	Valid
Building 2 icon	Click text or box of building 2	Display a new page containing various things and various works that exist in museum building 2	Valid
Building 3 icon	Click text or box of building 3	Display a new page containing various things and various works that exist in museum building 3	Valid
Building 4 icon	Click the text or box of building 4	Display a new page containing various things and various works that exist in museum building 4	Valid
Button “More Details”	Click the button “More Details”	Display a new page containing all ofthe building organization of the museum	Valid
Body Page 1			
Button “View Details” on 3D Artifacts – Human Statue	Click the button “View Details” on 3D Artifacts – Human Statue box	Display a new page containing all of the historical artifacts on a 3D model	Valid
Button “View Details” on Statue	Click the button “View Details” on the Statue box	Display a new page containing all of the Statue on the museum	Valid
Button “View Details” on Reliefs	Click the button “View Details” on the Reliefs box	Display a new page containing all of the reliefs on 3Dobjects inthemuseum	Valid
Button “View Details” on the Art Picture	Click the button “View Details” on the Art Picture box	Display a new page containing all ofthe pictures and art (photo) in the museum	Valid
Body Page 2			
Button “View All Artifacts”	Click the Button “View All Artifacts”	Displaying all artifacts in 3D format but unable to zoom in and unable to be viewed in 360°, it appears as thumbnails and can only be rotated left and right	Valid
Button “View All AR Code”	Click the Button “Vie All AR Code”	It is displaying all AR codes that can be scanned to view artifact objects in 3D format. In this case, artifacts can be rotated 360°, can be rotated and zoomed in or out. Additionally, the object’s location can also be easily relocated to desired locations	Valid
Body Page 3			
AR Code 1	Scan AR Code 1 using a smartphone (android/iOs) camera	Display 3D object for Object 1 (specific Artifact suggest by the museum)	Valid
AR Code 2	Scan AR Code 2 using a smartphone (android/iOs) camera	Display 3D object for Object 2 (specific Artifact suggest by the museum)	Valid
AR Code 3	Scan AR Code 3 using a smartphone (android/iOs) camera	Display 3D object for Object 3 (specific Artifact suggest by the museum)	Valid
AR Code 4	Scan AR Code 4 using a smartphone (android/iOs) camera	Display 3D object for Object 4 (specific Artifact suggest by the museum)	Valid
AR Code 5	Scan AR Code 5 using a smartphone (android/iOs) camera	Display 3D object for Object 5 (specific Artifact suggest by the museum)	Valid
AR Code 6	Scan AR Code 6 using a smartphone (android/iOs) camera	Display 3D object for Object 6 (specific Artifact suggest by the museum)	Valid
Body Page 4 and Footer			
Image 1	Click Image 1	Display photo/image/picture 1 (specific picture as displayed on box)	Valid
Image 2	Click Image 2	Display photo/image/picture 2 (specific picture as displayed on box)	Valid
Image 3	Click Image 3	Display photo/image/picture 3 (specific picture as displayed on box)	Valid
Image 4	Click Image 4	Display photo/image/picture 4 (specific picture as displayed on box)	Valid
Image 5	Click Image 5	Display photo/image/picture 5 (specific picture as displayed on box)	Valid
Image 6	Click Image 6	Display photo/image/picture 6 (specific picture as displayed on box)	Valid
Image 7	Click Image 7	Display photo/image/picture 7 (specific picture as displayed on the box)	Valid
Image 8	Click Image 8	Display photo/image/picture 8 (specific picture as displayed on the box)	Valid
Image 9	Click Image 9	Display photo/image/picture 9 (specific picture as displayed on box)	Valid
Messages box	Type some text as a message (critique, recommendation, or question) inthemessage box	Box can be filled with text input by the user without loading or delayed and without limited text	Valid
Button “Submit” of the message box	Click the button “Submit”	Message (feedback form) send successfully	Valid

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