ISSN No:-2456-2165 https://doi.org/10.38124/ijisrt/26mar1067

AR Museum: Exploring the Augmented Reality Experience in Neust Museum

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Publication Date: 2026/03/30

Abstract: This study explores the development and evaluation of an Augmented Reality (AR) Museum experience at the NEUST Museum, employing an agile development approach and adhering to ISO/IEC 25010 software quality standards. The research aims to assess how AR can enhance visitor engagement, learning, and overall satisfaction by integrating features such as virtual reconstructions, interactive storytelling, and multisensory elements. Through qualitative and quantitative evaluations involving IT experts and end-users, the findings demonstrate that the AR system effectively improves visitor interaction and educational outcomes, although challenges such as device compatibility and performance optimization remain. The study contributes to the broader field of digital heritage preservation and museum education by providing insights into user-centered AR design, iterative development processes, and the potential for advanced features like multi-user experiences and AI-driven personalization. These findings underscore AR's transformative role in creating immersive, accessible, and engaging cultural experiences, offering a scalable model for future digital heritage initiatives and educational applications.

Keywords: *AR, Museum, Digital Heritage, User Experience, Agile Development, ISO 25010*

How to Cite: Genesis Benmark C. Laguna; Dr. Rolaida Sonza (2026) AR Museum: Exploring the Augmented Reality Experience in Neust Museum. *International Journal of Innovative Science and Research Technology*, 11(3), 2524-2554. https://doi.org/10.38124/ijisrt/26mar1067

I. INTRODUCTION

Traditional museums, while providing valuable historical and cultural insights, often face challenges in engaging younger generations and catering to diverse learning styles. This limitation can result in decreased interest and learning outcomes, particularly among students and visitors accustomed to interactive and technology-driven experiences. The successful integration of technology in the NEUST Museum demands careful consideration of the potential problems and solutions for various stakeholders. Faculty might face challenges in integrating AR experiences into their curricula, requiring training and support to effectively utilize this technology. Students could encounter technical barriers, accessibility issues, or find the AR experience unengaging, leading to decreased learning outcomes. Museum administrators need to address the costs, maintenance, and visitor engagement aspects of implementing AR. For other visitors, technical difficulties, accessibility barriers, and privacy concerns could arise.

The integration of Augmented Reality (AR) technology into NEUST museums presents a transformative opportunity for educational institutions, offering a more engaging, interactive, and accessible way to learn and explore. AR emerges as a powerful solution, addressing the limitations of traditional museum experiences and paving the way for a more dynamic and immersive learning environment. To overcome these challenges, solutions must be developed. These include providing faculty with training and resources for AR integration, ensuring accessibility for all students, offering technical support and engaging content, exploring cost-effective AR solutions, establishing clear maintenance procedures, and implementing mechanisms for gathering visitor feedback. By addressing these concerns, the NEUST Museum can create a successful and impactful AR experience that enhances learning, accessibility, and engagement for all visitors.

- *Synthesis*

Augmented reality (AR) holds immense potential to revolutionize the museum experience, offering immersive, interactive, and engaging ways to explore exhibitions (Kennedy et al., 2021; Volkan et al., 2023). However, the effectiveness of AR in enhancing visitor engagement and learning requires careful examination within specific contexts. This research, "AR Museum: Exploring the Augmented Reality Experience in NEUST Museum," delves into the practical application of AR within the unique setting of the NEUST Museum. Moving beyond general claims of AR's transformative power, this study investigates how the specific features and functionalities of the NEUST Museum's AR implementation impact visitor engagement, comprehension, and overall enjoyment. Furthermore, it critically assesses the

ISSN No:-2456-2165 https://doi.org/10.38124/ijisrt/26mar1067

benefits and challenges of integrating AR technology into this particular museum environment, considering factors such as accessibility, technical proficiency required of visitors, and the economic implications of AR deployment. By gathering rich qualitative data through focus groups and in-depth interviews with NEUST Museum visitors, this research aims to provide a nuanced understanding of how AR is perceived and experienced, contributing valuable insights for museums considering or implementing similar technologies. The study seeks to answer whether AR truly elevates the museum visit for all users, or if unforeseen barriers exist that limit its potential.

➢ *Conceptual Framework*

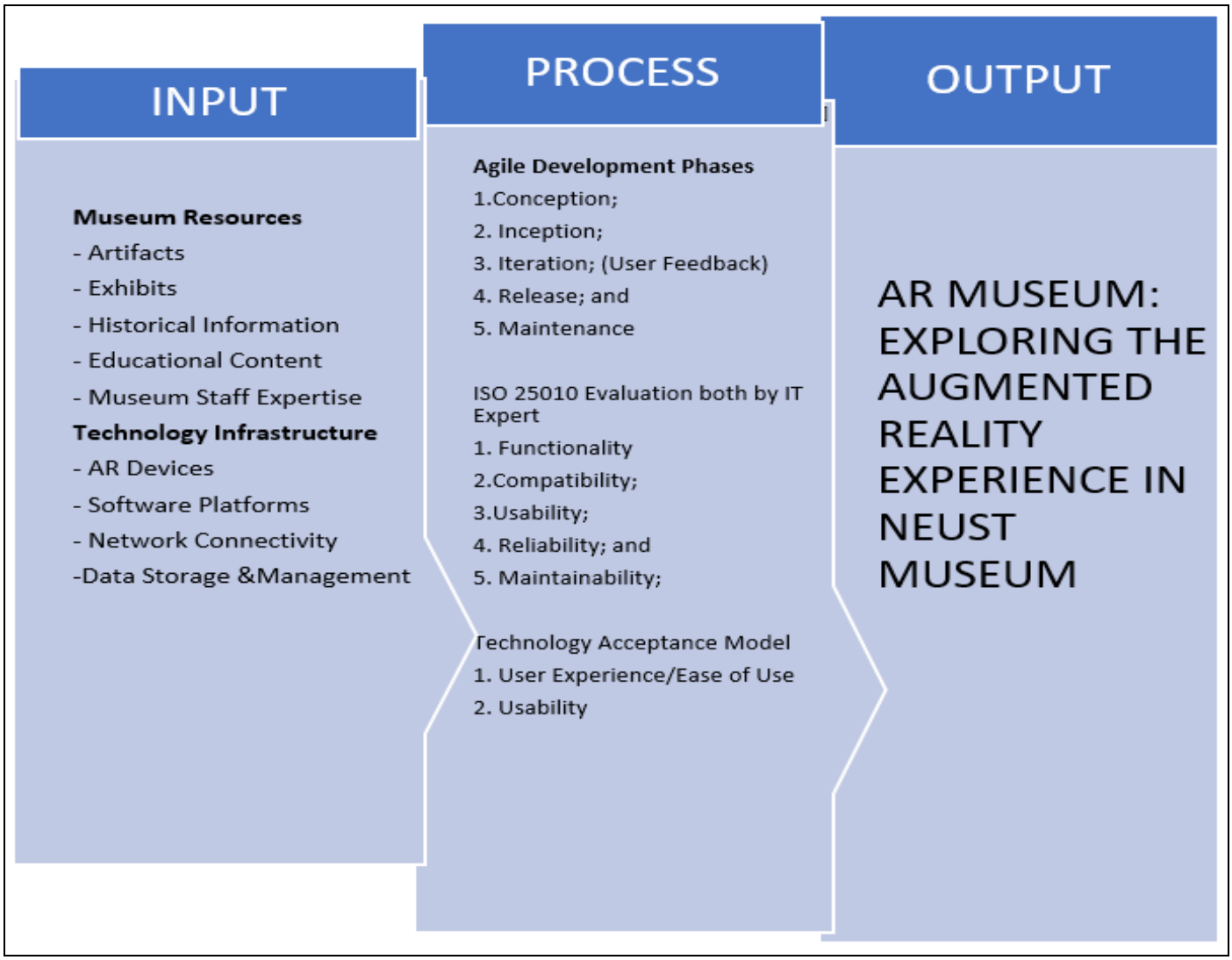

Fig 1 Conceptual Framework

The framework offers a methodical way to design and assess an augmented reality museum experience. A fully functional and assessed AR museum is the end result of a methodical development process that begins with the identification of required resources and includes stringent quality assurance and user acceptance testing. The framework highlights how crucial both technical functionality and user experience are to the project's success.

- INPUT: This section identifies the resources and infrastructure required for the project. Museum Resources includes the core content of the museum artifacts, exhibits, historical information, and educational materials. The expertise of the museum staff is also crucial.

Technology Infrastructure covers the technological requirements, such as AR devices (smartphones, tablets), software platforms to create and run the AR experience, network connectivity to ensure smooth operation, and data storage and management systems to handle the data generated by the AR experience.

- PROCESS: This section details the stages and evaluation methods used in developing the AR museum. Agile Development Phases the AR experience will be developed using an agile methodology, which involves iterative development and continuous feedback. The phases include conception, inception (planning), iteration (development cycles), release (launch), and maintenance (ongoing updates and support).

ISSN No:-2456-2165 https://doi.org/10.38124/ijisrt/26mar1067

- OUTPUT: This section describes the expected outcome of the project.

- AR Museum: Exploring the Augmented Reality Experience in NEUST Museum. This is the final product a functioning AR museum experience that enhances the visitor experience. The success of the project will be measured by how well it meets the criteria outlined in the "Process" section.

A strong conceptual framework underpins the design and development of the proposed Augmented Reality Museum. This framework leverages Augmented Reality principles to overlay digital information, enhancing visitor engagement. Educational theories like constructivism and experiential learning guide the design, ensuring AR components effectively support learning objectives. User-Centered Design is central, prioritizing user needs and feedback throughout the development lifecycle. The Technology Acceptance Model (TAM) serves as the evaluation model, focusing on perceived usefulness and ease of use as indicators of success. The ISO 25010 Software Quality Model provides a framework for assessing functionality, reliability, usability, and other critical system qualities. An Agile Development Methodology is employed for its iterative approach, enabling continuous adaptation based on user input and evolving project requirements. The development process follows Agile phases: Conception, Inception, Iteration, Release, and Maintenance. Finally, the evaluation process, incorporating both ISO 25010 and TAM, comprehensively assesses the AR museum, with IT experts evaluating technical aspects and user feedback shaping the TAM assessment of user experience and usability.

➢ *Research Problem*

The framework offers a methodical way to design and assess an augmented reality museum experience. A fully functional and assessed AR museum is the end result of a methodical development process that begins with the identification of required resources and includes stringent quality assurance and user acceptance testing. The framework highlights how crucial both technical functionality and user experience are to the project's success.

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➢ *Scope and Delimitation*

- *What is the Research About?*

The research is about exploring the augmented reality (AR) experience within the NEUST Museum. It's all about understanding how AR impacts visitor engagement, how happy they are with it, and how well they understand the museum's collection because of it.

- *When will the Research take Place or what Time Period does it Cover?*

The provided text doesn't specify a time period, so we can assume it's a contemporary study, focusing on the current AR implementation (or planned implementation) at the NEUST Museum. If there's a specific timeframe (like a season, or academic year), it would be good to include that!

- *Where will the Research be Conducted?*

The research will exclusively be conducted at the NEUST Museum. This is a key delimitation you're not comparing it to other museums.

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- *How will the Research be Conducted?*

The research will gather data through surveys, interviews, and observations. It will focus on the perspectives of NEUST Museum visitors and staff.

- *Why is this Research Important?*

The research aims to understand the effectiveness of AR in enhancing the visitor experience. It also seeks to identify the challenges and opportunities of using AR in a museum setting, considering things like cost, technical stuff, and making sure everyone can use it.

➢ *Significance of the Study*

The result of the study will be of great benefit to the following:

To the Researcher. As the primary investigator, the researcher will gain valuable experience in conducting research, analyzing data, and disseminating findings. This study will contribute to their professional development and expertise in the field of augmented reality and museum studies.

To the Nueva Ecija University of Science and Technology. It enhance the reputation implementing innovative AR technology can enhance NEUST's reputation as a forward-thinking institution.

To the Faculty. This research can serve as a springboard for faculty to explore new pedagogical approaches using AR technology. The study's findings can inform the development of engaging and interactive learning experiences within the museum context.

To the Museum Staff. The research can help museum staff understand how AR technology can be effectively implemented to enhance visitor engagement, accessibility, and enjoyment. This can lead to the development of interactive AR experiences that enrich the museum visit.

To the Students. The AR can make NEUST more attractive to prospective students and faculty by showcasing its commitment to technological advancements.

To the Research Collaboration Opportunities The study can lead to further research collaborations with other institutions and organizations interested in AR technology.

➢ *Definition of Terms*

To ensure clarity and consistency throughout this study, the following terms are defined as they are used within the context of this research. These definitions are based on a combination of conceptual and operational approaches, providing both theoretical understanding and practical application within the study's scope.

- 3D Models - Allowing visitors to view and interact with virtual representations of artifacts or historical objects.
- 360-Degree Views - Allowing visitors to explore a virtual space from all angles.
- AR Museum - An AR museum is a museum that incorporates augmented reality technology into its exhibits, enhancing the visitor experience through interactive elements, digital information, and immersive displays.
- Audio Narrations - Offering audio guides or interactive stories related to the exhibits.
- Augmented Reality (AR) - Augmented reality (AR) is a technology that overlays computer-generated images, sounds, or other sensory information onto a user's view of the real world, thus enhancing their perception of reality.
- Augmented Reality Games - Engaging visitors in interactive challenges or puzzles related to the museum's exhibits.
- Compatibility - Refers to the ability of two or more things to work together effectively and seamlessly. It's about ensuring that different components, systems, or devices can interact with each other without issues or conflicts.
- Digital Information - This refers to the virtual content provided through AR, such as:
- Functionality - Attribute to the features and capabilities of a system, product, or service that authorize it to perform its intended tasks. It's essentially what a system does and how well it does it.
- Immersive Displays - This refers to AR experiences that create a sense of presence and immersion within the virtual environment, such as:
- Interactive Elements - These are features within an AR experience that allow visitors to engage with the virtual content, such as: actively
- Interactive Projections - Projecting AR content onto physical objects or surfaces to create dynamic displays.
- Maintainability - Refers to the ease with which a system, product, or service can be modified, repaired, or enhanced over time. It's about how easy it is to keep a system working well and adapt it to changing needs or requirements.
- Museum Frequency - This helps you understand how often they engage with museums and their potential prior experiences with museum exhibits.
- NEUST Museum - This refers to the specific museum at the Nueva Ecija University of Science and Technology (NEUST) where your research will be conducted. It's important to understand the museum's unique collection, target audience, and existing infrastructure to evaluate the effectiveness of AR implementation.
- Reliability - In the context of technology and systems, refers to the consistency and dependability of a system or product to perform its intended functions accurately and without failure under specified conditions. It's about how much you can trust a system to do what it's supposed to do, when you need it to.
- Simulated Environments - Creating virtual replicas of historical settings or environments.
- Textual Information - Providing additional context, historical background, or explanations about exhibits.
- Touchscreen Interfaces - Allowing visitors to manipulate objects, explore information, or play games.
- Usability - Refers to the ease with which a system, product, or service can be used to achieve a specific goal.

ISSN No:-2456-2165 https://doi.org/10.38124/ijisrt/26mar1067

It's about how easy, efficient, and enjoyable it is for users to interact with a system and accomplish their tasks.
- Video Content - Presenting documentaries, animations, or other multimedia content to enhance understanding.
- Visitor Experience - This encompasses the overall impression, engagement, and understanding a visitor gains from interacting with a museum's exhibits and environment.

II. RESEARCH METHODOLOGY

This study employs a mixed methods research design, specifically a sequential exploratory design. This approach involves two distinct phases: qualitative data collection and analysis, followed by quantitative data collection and analysis. This design is appropriate because it allows for an in-depth understanding of the context and issues surrounding AR implementation in the NEUST Museum through the qualitative phase, which then informs the development and evaluation of the AR system in the quantitative phase.

➢ *Qualitative Phase*

In the first phase, qualitative data will be gathered through semi-structured interviews with museum staff, educators, and IT professionals. These interviews will explore the procedures of the existing museum system, the challenges encountered in engaging visitors, and their perspectives on the potential of AR technology. The data collected will be analyzed using thematic analysis to identify key themes and patterns related to the research questions.

➢ *Quantitative Phase*

The second phase involves the collection of quantitative data through a survey administered to museum visitors and students. The survey will evaluate the usability, effectiveness, and overall satisfaction with the developed AR system. The survey instrument will be designed based on the findings from the qualitative phase, ensuring that it addresses the key issues and concerns identified by the participants. The data collected will be analyzed using descriptive statistics and inferential statistics to determine the impact of the AR system on visitor engagement, learning outcomes, and overall museum experience.

➢ *Development Approach*

In the development of the AR system, an agile methodology will be used. This iterative and incremental approach allows for flexibility and adaptability throughout the development process. Regular feedback from stakeholders will be incorporated into each iteration, ensuring that the final product meets the needs and expectations of the NEUST Museum and its visitors.

By combining qualitative and quantitative methods, this research design provides a comprehensive and nuanced understanding of the AR experience at the NEUST Museum. The qualitative phase informs the quantitative phase, allowing for a more targeted and meaningful evaluation of the AR system. The agile development approach ensures that the system is user-centered and responsive to the evolving needs of the museum and its visitors.

➢ *Locale of the Study*

The study will be conducted at Nueva Ecija University of Science and Technology sumacab campus, located in Cabanatuan City province of Nueva Ecija. The study aims to develop and implement the AR Museum: Exploring the Augmented Reality Experience in NEUST Museum that will make visitors an exceptional experience in viewing the collections of NEUST Museum through Augmented Reality.

ISSN No:-2456-2165 https://doi.org/10.38124/ijisrt/26mar1067

Fig 2 NEUST Museum, Sumacab Campus

Fig 3 Google Map of the Research Locale

➢ *Respondents*

The table below shows the summary of the respondents:

Table 1 Respondents

Respondents	Number of Respondents	Percentage
IT Professional	10	8.26%
Educators	10	8.26%
Students	100	82.64%
Museum Admin	1	0.82%
total	121	100%

This study employs a combination of purposive and convenience sampling techniques to select participants who can provide valuable insights into the AR experience at the NEUST Museum. Purposive sampling is used to select IT Professionals, Educators, and Museum Admin based on their expertise and experience relevant to the study's objectives. Convenience sampling is used to select Students that are readily available and willing to participate.

IT Professionals these respondents will evaluate the technical aspects of the AR experience. They possess experience with AR development, web technologies, user interface design, and accessibility. They are recruited from the NEUST IT department, local AR development companies, university-affiliated research labs, and professional organizations for IT professionals. A sample size of 10 IT Professionals is deemed appropriate to gather diverse technical perspectives while ensuring manageability of data collection and analysis.

Educators these 10 respondents will evaluate the educational value and potential of the AR experience. They have experience in museum education, curriculum development, and pedagogy. They are NEUST faculty members (especially in history, art, museum studies, or related fields) and local museum educators. A sample size of 10 Educators allows for representation of different educational viewpoints and alignment with curriculum goals.

Students These 100 respondents are the end-users who will evaluate the user experience and accessibility of the AR experience. They are recruited from the College of Education in NEUST and other students, forming a diverse group representing different age groups, technological skills, and academic backgrounds. Local senior high school students are also targeted as respondents. A sample size of 100 Students provides a broad representation of the user population, enabling the identification of common usability issues and preferences.

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Museum Admin as the end-user, the 1 Museum Admin will evaluate the AR experience's alignment with the museum's mission, goals, and operational needs. They have experience in museum management, operations, and visitor engagement. The inclusion of the Museum Admin ensures that the AR implementation aligns with the museum's strategic objectives and operational constraints.

The sample sizes for each group are determined based on a balance between the need for diverse perspectives, the feasibility of data collection, and the scope of the study. While these sample sizes may not be statistically representative of the entire population, they are sufficient to provide valuable insights and inform the development of a user-centered AR experience at the NEUST Museum.

➢ *Research Instruments*

The system evaluation questionnaires were based on the ISO/IEC 25010 Software Product Quality Standards, which include eight criteria: functionality, usability, and maintainability. Also, the items will be rated by using a four-point Likert scale.

The questionnaire is composed 31 items; three items each for the criteria of functional suitability and performance efficiency, two items for the criteria of compatibility, six items for the criteria of usability, four items for the criteria of reliability, five items for the criteria of security, five items for maintainability, and three items for portability.

To interpret the data acquired in compliance with the specified ISO 25010 Software Quality Standards, the following scoring guide was used:

Table 2 shows the scoring guide for Functional Suitability. This characteristic represents the degree to which the NEUST AR Museum met stated and implied needs. IT Experts and End users used this criterion to assess the system.

ISO 25010 Evaluation the AR system's quality will be assessed using the ISO 25010 standard for software product quality. This standard focuses on five key characteristics:

- Functionality does the AR system do what it's supposed to do? Does it provide the intended features and capabilities?
- Compatibility does the AR system work with different devices and software?
- Usability is the AR system easy to use and understand? Is the user experience positive?
- Reliability is the AR system dependable and consistent? Does it function without frequent errors or crashes?
- Maintainability is the AR system easy to update, maintain, and modify?
- Technology Acceptance Model (TAM): This model will be used to assess user acceptance of the AR technology. It focuses on: User Experience/Ease of Use: How easy is it for users to learn and use the AR system?

Usability (Reiterated from ISO 25010 for emphasis)

Table 2 Response Mode for Functionality

Response	Interpretations	Descriptor
4	Very Functional	Efficiently meets all the stated and implied needs; and no weaknesses are found.
3	Functional	Satisfactorily meets all the stated and implied needs but acceptable / tolerable weaknesses are found which will however not affect its function
2	Slightly Functional	Meets only some of the stated and implied needs and minor weaknesses are found that will slightly affect its function.
1	Not Functional	Meets very few stated and implied needs; and major weaknesses are found that will greatly affect its function.

Table 3 presents the scoring guide for Usability. IT Experts and End – users assessed the system based on this criterion. Usability refers to the degree to which specified users can use the System.

Table 3 Response Mode for Usability

Response	Interpretations	Descriptor
4	Very Usable	Provides a user interface that is easy to operate and control such that the users can effortlessly perform their appropriate needs even without guide or supervision.
3	Usable	Provides a user interface that is easy to operate and control such that the users can easily perform their appropriate needs with minimal guide or supervision.
2	Slightly Usable	Provides a user interface that is slightly difficult to operate and control such that the users cannot easily perform their appropriate needs.
1	Not Usable	Provides a user interface that is difficult to operate and control such that it is difficult for the users to perform their appropriate needs at all. Thus restructuring is required for the MTA.

Table 3 shows the response mode to be used in evaluating the usability of the NEUST AR Museum system.

Table 4 shows the response mode to be used in evaluating the reliability of the System.

Table 4 Response Mode on Reliability

Response	Verbal Description	Descriptors
4	Highly Reliable	Performs its operations without fail under specified conditions and over a certain period of time with no flaws.
3	Reliable	Performs its operations satisfactorily under specified conditions and for a set amount of time with minimal flaws that do not influence the system's overall reliability.
2	Needs Improvement	With serious defect that will undermine the system's overall reliability, it performs only part of its operation without failure under specified conditions and for a specified length of time.
1	Poor	Cannot perform any of its functions without failing under certain conditions and during a specified amount of time, requiring restructuring.

The Reliability criterion refers to the degree to which the system executes specified functions under specified conditions for a set amount of time. In this phase, the application will be evaluated in terms of maturity, availability, fault tolerance and recoverability.

ISSN No:-2456-2165 https://doi.org/10.38124/ijisrt/26mar1067

Table 5 shows the response mode to be used in evaluating the security of the NEUST AR Museum

Table 5 Response Mode on Security

Response	Verbal Description	Descriptors
4	Highly Secured	Protects information and data effectively without flaws.
3	Secured	Protects information and data satisfactorily with minimal flaws that do not compromise the system's overall security.
2	Needs Improvement	Only protects some of its information and data, and there are significant flaws in the system's overall security.
1	Poor	No information or data can be protected; thus, restructuring is necessary.

The Security criterion refers to the degree to which the system protects the information and data of the organization so the person, other product, and/or system have the degree of data accessed appropriate to their levels of authorization. In this phase, the application will be evaluated in terms of confidentiality, integrity, accountability.

Table 6 shows the response mode to be used in evaluating the maintainability of the NEUST AR Museum system.

Table 6 Response Mode on Maintainability

Response	Verbal Description	Descriptors
4	Highly Maintainable	Maintains its original shape efficiently and can be restored to that form in the event of failure with no flaws.
3	Maintainable	Maintains its original shape satisfactorily and can be restored to it in the event of failure with minimum flaws that do not affect its general maintainability.
2	Needs Improvement	In the event of failure with mild deficiencies that may influences its overall maintainability, just some of its original features are retained and restored.
1	Poor	It is impossible to keep and restore its original shape in the event of failure, thus restructuring is required.

The Maintainability criterion refers to how well the application can be adjusted to improve, correct, or adapt to changes in the environment and requirements. In this phase, the application will be evaluated in terms of modularity, reusability, analyzability and modifiability.

Table 6 shows the response mode to be used in evaluating the portability of the NEUST Museum System.

Table 7 shows the response mode to be used in evaluating the level of effectiveness of NEUST AR Museum system.

Table 7 Response Mode on the Level of Acceptability of the NEUST AR Museum system

Response	Verbal Description	Descriptors
4	Highly Acceptable	In terms of acceptability, it fits all of the stated criteria excellently, and there are no flaws in the system's execution.
3	Acceptable	Very satisfactorily fits all of the mentioned criteria in terms of acceptability, and acceptable tolerable flaws have been discovered that will not affect the system's functionality.
2	Needs Improvement	Only fit part of the specified criteria in terms of acceptability and minor flaws have been discovered that will have a minor impact on the system's implementation.
1	Not Acceptable	Fairly satisfactorily meets very few specified requirements in terms of effectiveness, and severe flaws are discovered that will have a significant impact on the system's implementation.

➢ *Usability*

- *Ease of Use*

✓ *How easy was it to understand and use the AR system?*

▪ (Scale: 1-5, 1=Very Difficult, 5=Very Easy)

✓ *Did you find the instructions clear and easy to follow?*

▪ (Yes/No)

✓ *How intuitive was the navigation within the AR application?*

▪ (Scale: 1-5, 1=Not at all Intuitive, 5=Very Intuitive)

✓ *Did you encounter any difficulties using the AR system?*

▪ (If yes, please describe)

▪ System Responsiveness

✓ *How quickly did the AR system respond to your actions?*

▪ (Scale: 1-5, 1=Very Slow, 5=Very Fast)

✓ *Did you experience any delays or lag while using the AR system?*

▪ (Yes/No)

✓ *Did the AR features load quickly and smoothly?*

▪ (Yes/No)

▪ Technical Issues

✓ *Did you encounter any technical problems (e.g., crashes, glitches, errors) while using the AR system?*

▪ (Yes/No, If yes, please describe)

▪ Was the AR system compatible with your device? (Yes/No)

➢ *Functionality*

- *AR Features*

✓ *How useful did you find the AR features (e.g., 3D models, interactive elements, information overlays)?*

▪ (Scale: 1-5, 1=Not at all Useful, 5=Very Useful)

✓ *Did the AR features enhance your understanding of the exhibits?*

▪ (Yes/No)

ISSN No:-2456-2165 https://doi.org/10.38124/ijisrt/26mar1067

✓ *Did the AR features make the museum visit more enjoyable?*

- (Yes/No)

✓ *Was the information presented in the AR application clear, accurate, and easy to understand?*

- (Scale: 1-5, 1=Not at all Clear, 5=Very Clear)

✓ *Was there enough information provided in the AR application?*

- (Too little/Just right/Too much)

- Was the information presented in an engaging way? (Yes/No)

➢ *Overall Acceptability:*

- *Overall Satisfaction*

✓ *How satisfied were you overall with your experience using the NEUST AR Museum system?*

- (Scale: 1-5, 1=Very Dissatisfied, 5=Very Satisfied)

✓ *Would you recommend this AR system to other visitors?*

- (Yes/No)

✓ *Would you use this AR system again on your next visit?*

- (Yes/No)

The level of acceptability criterion was used to identify how effective the application is during its implementation and review of the IT experts and end-users.

➢ *Validity and Reliability of the Instrument*

The determination of validity and reliability is a crucial step in ensuring the quality and trustworthiness of the research findings. In this study, the validity and reliability of the survey instrument will be assessed before the instrument is used for data collection. This process ensures that the instrument measures what it is intended to measure (validity) and that it produces consistent results over time and across different samples (reliability).

➢ *Content Validity*

To establish content validity, the researcher will seek the evaluation of the instrument from the advisory committee, who are experts in the field. The advisory committee will review the instrument to ensure that it covers all the relevant aspects of the research topic and that the items are clear, concise, and unambiguous. A number of consultations and discussions will be made to refine the instrument based on the feedback from the advisory committee.

➢ *Pilot Testing*

Before the main data collection, the instrument will be pilot-tested with a small sample of participants who are representative of the target population. This will help to identify any potential problems with the instrument, such as confusing wording, ambiguous instructions, or items that are difficult to answer.

➢ *Reliability Analysis*

After the pilot test, the data collected will be analyzed to assess the internal consistency reliability of the instrument. Cronbach's alpha will be used to measure the extent to which the items in the instrument are measuring the same construct. A Cronbach's alpha coefficient of 0.70 or higher will be considered acceptable.

The results of the validity and reliability analysis will be reported in the methodology section of the research report. Any modifications made to the instrument based on the results of the analysis will also be documented.

➢ *Data Gathering Procedures*

Having been an employee for several years, the researcher sought permission and was granted the chance by the University President to carry out a series of interviews with the intended end-users from NEUST Museum, Nueva Ecija. This aims to gather important information to aid the application's development.

For the research tool, the researcher will obtain the advisory committee's approval and send a letter to the University President to request permission to gather data from the intended system users. The advisory committee will generate and sanction An additional approval letter, allowing the researcher to collect data from the identified IT experts.

Both primary and secondary data were gathered while interviewing the end-users. The main data consisted of results from individual interviews regarding the system's expected performance. The secondary data include the forms, reports, and other processes that the application must be capable of performing and producing for the end-users. In addition to that, journal articles, newspapers, published resources, internet sites, and reference books from different authors were also utilized as secondary data for this research.

The information gathered from the questionnaire will be organized and compiled through microsoft word, which will subsequently undergo analysis and interpretation to yield the research findings.

➢ *Data Analysis Technique*

This research employs a mixed-methods approach, and the data analysis techniques will be tailored to address each research problem.

This research investigates the development and evaluation of an Augmented Reality Museum by addressing several core problems. The Agile development process, encompassing Conception, Inception, Iteration, Release, and Maintenance, will be meticulously documented through

ISSN No:-2456-2165 https://doi.org/10.38124/ijisrt/26mar1067

descriptive analysis of project records, sprint reports, and developer logs. IT experts will assess the AR museum's quality using the ISO/IEC 25010 standards, with survey data analyzed using descriptive statistics and potentially inferential statistics to compare different quality aspects. End-users will also evaluate the system based on selected ISO/IEC 25010 criteria, with their feedback summarized using descriptive statistics. System acceptance, focusing on user experience, ease of use, and usability, will be gauged through end-user surveys and analyzed using descriptive statistics. Lastly, the study's broader impact on the university and its MSIT Program will be examined through thematic analysis of stakeholder interviews, identifying key themes and patterns.

➢ *Ethical Concerns*

This research, involving human participants, necessitates a strong emphasis on ethical considerations to protect participants and ensure the integrity of the data collected. The researcher recognizes the importance of obtaining informed consent, maintaining confidentiality, and minimizing potential harm to participants. This section outlines the specific ethical measures that will be implemented throughout the study.

Informed Consent prior to participation, all respondents will be provided with a clear and comprehensive explanation of the study's purpose, procedures, potential risks and benefits, and their right to withdraw at any time without penalty. A written consent form will be obtained from each participant, ensuring their voluntary agreement to participate.

Confidentiality and Anonymity all data collected will be treated with the utmost confidentiality. Participants' identities will be protected through the use of pseudonyms or codes in all research materials. Data will be stored securely and accessed only by the research team. In the case of interviews, participants will be informed that their responses will be anonymized in any publications or presentations resulting from the study.

Voluntary Participation participation in this study is entirely voluntary. Respondents will be informed that they are free to decline to answer any question or withdraw from the study at any time without consequence.

Minimizing Harm the researcher will take precautions to minimize any potential psychological or emotional distress to participants. The interview questions will be carefully designed to avoid sensitive or potentially upsetting topics. If a participant expresses discomfort or distress, the interview will be terminated immediately.

Data Security all electronic data, including survey responses and interview transcripts, will be stored on password-protected computers and encrypted to prevent unauthorized access. Physical data, such as consent forms, will be stored in a locked cabinet.

Ethical Review this research proposal will be submitted to the NEUST Ethics Review Committee for approval prior to the commencement of data collection. The researcher will comply with all guidelines and recommendations provided by the committee.

By adhering to these ethical principles, the researcher aims to conduct a study that is both rigorous and respectful of the rights and well-being of all participants.

III. RESULTS AND DISCUSSION

➢ *Conception*

This is the initial stage where you identify the need for the AR Museum and define the project's scope and objectives.

The Conception phase lays the groundwork for the AR Museum System by establishing its purpose and scope. This begins with Identifying Stakeholders, encompassing (museum admin, students, educators, IT professionals), potential visitors (local community members, tourists), developers (AR specialists, software developers), researchers (educational technology experts, usability testers), teachers and students (from NEUST and surrounding schools), and NEUST administrators.

- How will it uniquely transform the visitor experience?

➢ *Bringing History to Life*

Instead of just reading about historical events, visitors could use AR to see virtual recreations of those events unfolding before them, overlaid onto the real-world museum environment. For example, standing in front of an ancient pottery shard, a visitor might see a virtual potter at work, crafting a similar vessel.

➢ *Personalized Learning Journeys*

AR can tailor the museum experience to individual interests and learning styles. Visitors could choose specific themes or topics to explore, and the AR app would guide them through relevant exhibits, providing customized content and interactive activities based on their selections.

➢ *Interactive Storytelling*

AR can transform static exhibits into dynamic narratives. Visitors could trigger AR experiences that reveal hidden stories, behind-the-scenes information, or alternative perspectives related to the artifacts on display.

➢ *Multi-Sensory Experiences*

AR can combine visual elements with 3D models, haptic feedback, and even augmented scents to create more immersive and memorable experiences. For example, a visitor exploring a exhibit might feel a simulated tremor as a virtual artifacts stomps.

➢ *Bridging the Gap Between Physical and Digital*

AR seamlessly blends the physical and digital worlds, allowing visitors to interact with exhibits in new and innovative ways. Visitors could use AR to manipulate virtual objects, explore hidden layers of artifacts, or even "step inside" a painting to experience the artist's perspective.

ISSN No:-2456-2165 https://doi.org/10.38124/ijisrt/26mar1067

➢ *Creating Shareable Moments*

AR experiences can be easily captured and shared on social media, allowing visitors to extend their museum experience beyond the physical space and promote the museum to their friends and followers. This could involve taking photos with virtual characters, creating AR-enhanced videos, or sharing their personalized learning journeys.

➢ *Extending the Museum Beyond its Walls*

AR experiences can be extended beyond the physical museum space, allowing visitors to continue learning and exploring from home. Visitors could use the AR app to access virtual exhibits, participate in online activities, or even create their own AR-enhanced content.

Preliminary Research is then conducted to gain a comprehensive understanding of the landscape. This includes exploring existing AR technologies and their applications in museum settings, analyzing visitor preferences and expectations through surveys and focus groups, and assessing the NEUST Museum's specific needs, resources (existing digital assets, available space), and infrastructure (Wi-Fi capabilities, device availability). A Feasibility Study follows, critically evaluating the technical, economic, and operational viability of the project.

- Can the proposed AR experience be realistically developed within the allocated budget, considering hardware costs, software licenses, and development time?

➢ *Web-Based System*

The AR Museum experience is entirely web-based, accessible through visitors' own mobile devices (smartphones, tablets, laptops).

➢ *Free 3D Models*

3D models are developed using Meshy.ai, a free platform.

➢ *React JS Development*

The web-based AR museum is built using React JS, a free and open-source JavaScript library.

➢ *NEUST Resources*

NEUST already possesses necessary server infrastructure, and personnel expertise.

➢ *Cost Breakdown (Focusing on Web Hosting)*

Given that the system is web-based and accessed through visitors' devices, the primary cost continues to be web hosting. However, since the 3D models are free and React JS is open-source, there are no software licensing fees.

- *The Key Factors Influencing Web Hosting Costs are:*

✓ Hosting Type Shared hosting, VPS (Virtual Private Server), or dedicated server.
✓ Storage Space The amount of storage needed for website files, code, and any other assets (though 3D models are assumed to be efficiently optimized).
✓ Bandwidth The amount of data transfer required to serve the website and AR experience to visitors.
✓ Traffic The number of visitors accessing the AR experience simultaneously.

- Are the necessary technical skills and expertise available, either in-house or through external partnerships?

Yes, the necessary technical skills and expertise are readily available in-house at NEUST Museum. The museum has dedicated staff members who are knowledgeable and experienced in IT-related fields. These staff members possess the skills and expertise required to maintain the web-based AR Museum system using React JS and Meshy.ai. Their expertise ensures that the project can be successfully executed and sustained without the need for external partnerships or costly outsourcing.

- Can the museum effectively manage and maintain the AR system in the long term?

Yes, the museum can effectively manage and maintain the AR system in the long term. Given that the system is web-based, utilizes free 3D models (Meshy.ai), is built with the open-source React JS library, and the primary ongoing cost is limited to web hosting, the long-term management and maintenance are highly feasible. The museum's IT staff can handle updates, content management, and basic troubleshooting with minimal additional resources or external support. The simplicity and cost-effectiveness of the chosen technologies ensure the AR system's sustainability and ease of maintenance for the NEUST Museum.

➢ *Inception*

This phase involves more detailed planning and preparation for the project.

The Inception phase takes the broad vision from Conception and transforms it into a concrete plan. This begins with Detailed Requirements Gathering, involving comprehensive interviews with museum curator, educators, and IT Professionals to understand their specific needs and goals. Surveys and focus groups with potential visitors are conducted to identify the AR features they would find most engaging (e.g., interactive 3D models, virtual tours) and educational (e.g., historical context, scientific explanations, cultural significance). A key aspect is aligning these features with the museum's specific learning objectives for different age groups and visitor types.

Prioritizing Features is crucial to manage scope and resources. Techniques like MoSCoW (Must have, Should have, Could have, Won't have) are employed to categorize features based on their value to visitors and the museum, as well as their technical feasibility and development cost. "Must have" features are essential for a functional AR experience, while "Should have" and "Could have" features are desirable but not critical. Features deemed "Won't have" are deferred to future iterations or excluded entirely.

ISSN No:-2456-2165 https://doi.org/10.38124/ijisrt/26mar1067

Creating User Stories translates the prioritized features into user-centric narratives. These stories describe the desired functionality from the user's perspective, following the format "As a [user role], I want [goal] so that [benefit]". For example: "As a student, I want to be able to scan an artifact with my smartphone and see a virtual reconstruction of it in its original form, so that I can better understand its historical context and function." Or: "As a teacher, I want to be able to create custom AR tours for my students, so that I can tailor the museum experience to our curriculum." Technical Design involves creating a high-level blueprint for the AR application. This includes selecting the appropriate technology stack (e.g., React JS for the web-based interface, AR.js for the AR functionality), choosing an AR framework (if necessary, although AR.js handles much of this), and defining the content management system (CMS) for managing and updating AR content.

The design also considers factors such as device compatibility, network requirements, and security considerations. Finally, Prototype Development involves building a basic prototype to test key AR features and gather initial feedback from stakeholders. This prototype might include a simple AR experience with a limited number of artifacts, interactive elements, and user interface components. The goal is to validate the technical feasibility of the AR design, identify potential usability issues, and refine the requirements based on real-world testing. This includes using prototype 3D models created via Meshy.ai. This prototype might include a simple AR experience with a limited number of artifacts, interactive elements, and user interface components. The goal is to validate the technical feasibility of the AR design, identify potential usability issues, and refine the requirements based on real-world testing.

- *Interviews with Museum Curator*

Fig 4 Interviews with Museum Curator

- *Basic Prototype to Test Key AR Features*

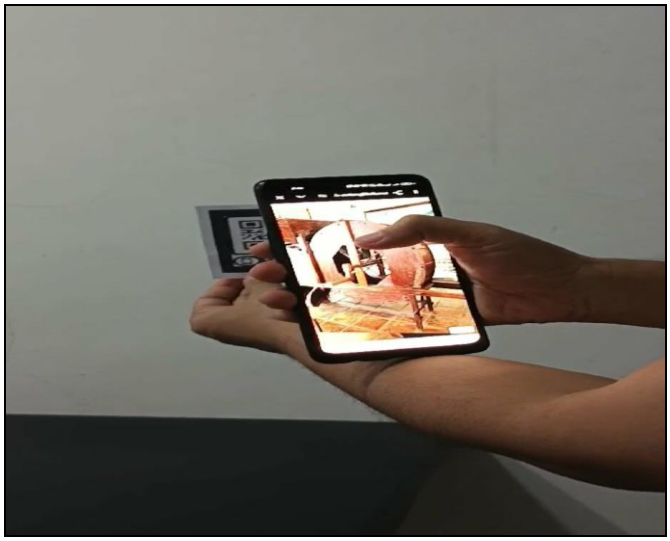

Fig 5 Basic Prototype to Test Key AR Features

- *Prototype 3D Models*

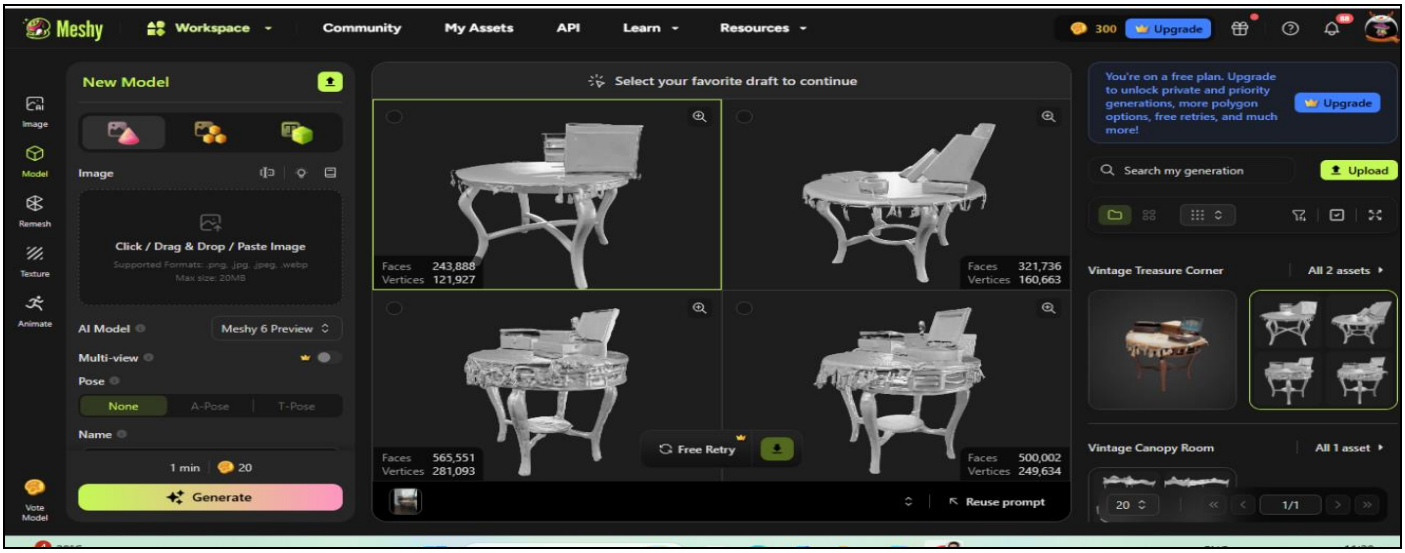

Fig 6 Prototype 3D Models

ISSN No:-2456-2165 https://doi.org/10.38124/ijisrt/26mar1067

➢ *Iteration*

This is the core of the Agile Model, involving iterative cycles of development, testing, and feedback.

The Iteration phase is where the AR Museum System comes to life through a series of short, focused development cycles called sprints. Sprint Planning begins each sprint, typically lasting 1-4 weeks. The developer, in collaboration with museum stakeholders, selects a set of prioritized user stories from the product backlog (created in the Inception phase) to be completed during the sprint. The team breaks down these user stories into specific tasks, estimates the effort required for each task. The sprint plan outlines the goals, tasks, and timeline for the sprint. Development is the core of the sprint, where the AR features are built according to the sprint plan. Developer write code, create 3D models (if new ones are needed), integrate AR functionality, and implement user interface elements. The focus is on delivering working software at the end of each sprint – a tangible increment of the AR Museum System that can be tested and demonstrated. Testing is an ongoing activity throughout the sprint. Developers conduct unit tests to verify the correctness of their code, and perform integration tests to ensure that different components of the system work together seamlessly. Crucially, museum staff and visitors are involved in user testing to gather feedback on usability, engagement, and overall satisfaction. This feedback is used to identify bugs, usability issues, and areas for improvement. Review and Feedback occurs at the end of each sprint. The development team demonstrates the completed work to stakeholders, including museum curators, educators, and IT professionals. Stakeholders provide feedback on the functionality, design, and overall quality of the AR features. This feedback is used to adjust the project plan, refine requirements, and prioritize features for the next sprint. The sprint review is also an opportunity to celebrate successes and identify areas for improvement in the development process. Finally, Continuous Integration practices are implemented to ensure that code changes are integrated and tested frequently. This involves using automated build and testing tools to detect integration issues early and prevent them from escalating. Continuous integration helps to maintain the stability and quality of the AR Museum System throughout the development process.

➢ *Developer Write Code, Create 3D Models*

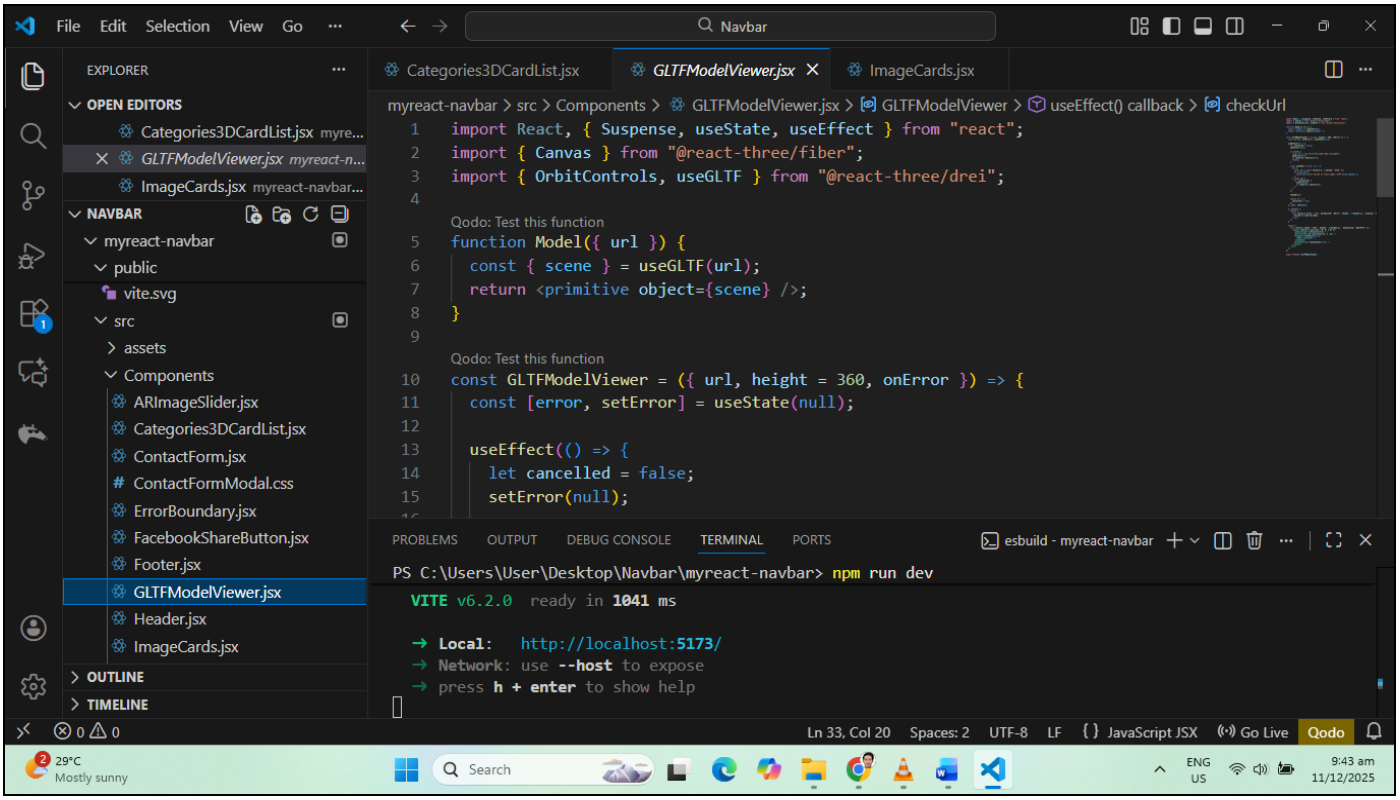

Fig 7 Developer Write Code, Create 3D Models

➢ *Release*

This phase involves deploying the AR Museum to the NEUST Museum and making it available to visitors.

The Release phase marks the culmination of the development effort, bringing the AR Museum System to the public. Deployment Planning is crucial to ensure a smooth and successful launch. This involves developing a detailed plan that addresses all aspects of the deployment process, including specifying hardware requirements (e.g., device compatibility, network infrastructure), outlining software installation procedures (e.g., app distribution, server configuration), and creating comprehensive user training materials (e.g., tutorials).

The deployment plan also includes a timeline, resource allocation, and communication strategy. A Pilot Launch is conducted in a limited area of the museum or with a select

ISSN No:-2456-2165 https://doi.org/10.38124/ijisrt/26mar1067

group of visitors. This allows the team to gather initial feedback on the AR experience in a real-world setting, identify any remaining issues (e.g., usability problems, performance bottlenecks, content errors), and refine the deployment process before a full-scale launch. The pilot launch provides valuable insights into visitor behavior, system performance, and the effectiveness of training materials. Full Deployment involves rolling out the AR Museum System to the entire museum. This includes ensuring that all exhibits are AR-enabled, that visitors have access to the necessary devices (if provided by the museum), and that the network infrastructure can support the increased traffic.

The deployment process is carefully monitored to identify and address any issues that arise. Once the system is fully deployed, the museum is officially transformed into an AR-enhanced experience. Training and Support are essential to ensure that both museum staff and visitors can effectively use the AR Museum System. Museum staff receive training on how to use the system, troubleshoot common issues, and provide support to visitors. Visitors are offered tutorials, and on-site assistance to help them navigate the AR experience and maximize its educational and entertainment value. Ongoing support is provided to address any questions or problems that arise after the launch.

- *Picture Museum Visitors Using Smartphones to Interact with AR Exhibits*

Fig 8 Picture Museum Visitors Using Smartphones to Interact with AR Exhibits

- *NEUST Museum IU Interface*

Fig 9 NEUST Museum IU Interface

ISSN No:-2456-2165 https://doi.org/10.38124/ijisrt/26mar1067

➢ *Artifacts 3D Models*

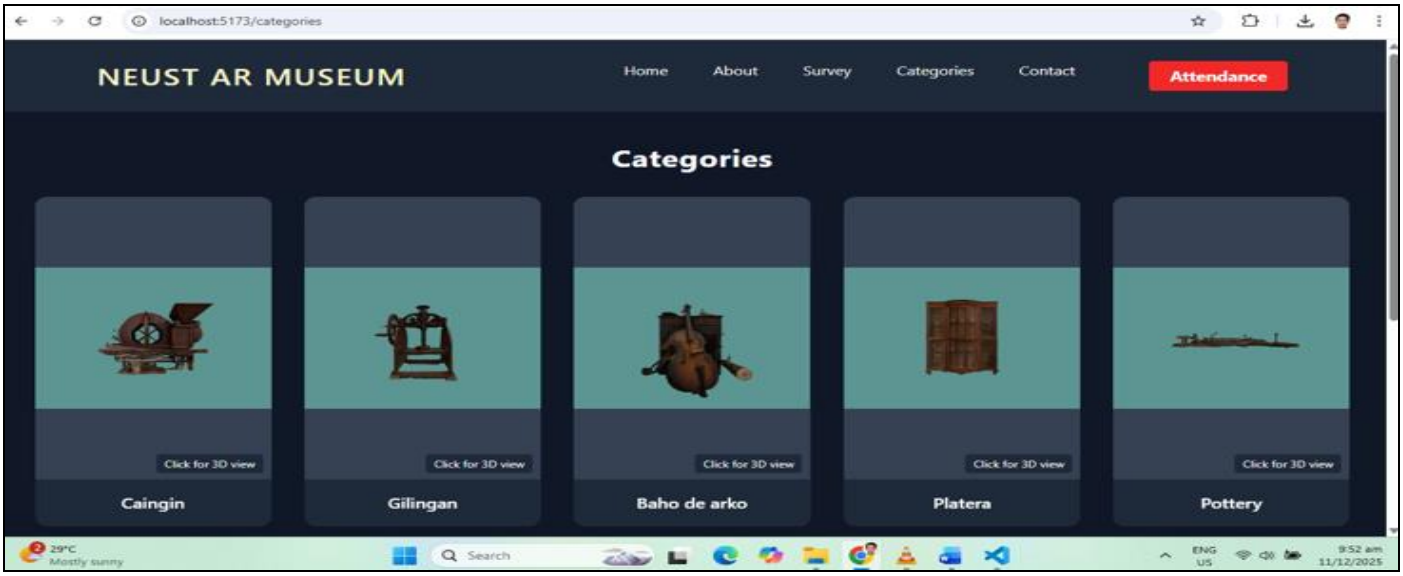

Fig 10 Artifacts 3D Models

➢ *Maintenance*

This phase involves ongoing support, updates, and improvements to the AR Museum.

The Maintenance phase ensures the long-term success and relevance of the AR Museum System by continuously monitoring, improving, and updating the experience. Monitoring and Evaluation involves continuously tracking the performance of the AR system using analytics tools. This includes monitoring Attendance, Survey and Reservation and application stability. Data is also gathered using Attendance form, Survey form and the Reservation form through website. Visitor satisfaction is measured through surveys, feedback forms, and online reviews. Bug Fixes and Updates are addressed promptly based on reports from museum staff and visitors. A system is in place for reporting bugs and tracking their resolution. Regular updates are released to improve system performance, fix bugs, add new features (based on visitor feedback and evolving technology), and enhance the overall user experience. These updates are carefully tested before being deployed to the live system. Content Updates are essential to keep the AR Museum experience fresh and engaging. New information, exhibits, and interactive elements are regularly added to the AR content. This might include new 3D models of artifacts, updated historical information.

Content updates are planned and scheduled in advance, and are coordinated with museum curators and educators. Feedback Collection is an ongoing process. The museum continues to collect feedback from visitors through various channels, including on-site surveys, online feedback forms, social media monitoring, and informal interviews. This feedback is carefully analyzed to identify areas for improvement and inform future development efforts. The feedback loop ensures that the AR Museum System remains responsive to visitor needs and expectations.

➢ *Survey Form and Survey Analytical Report*

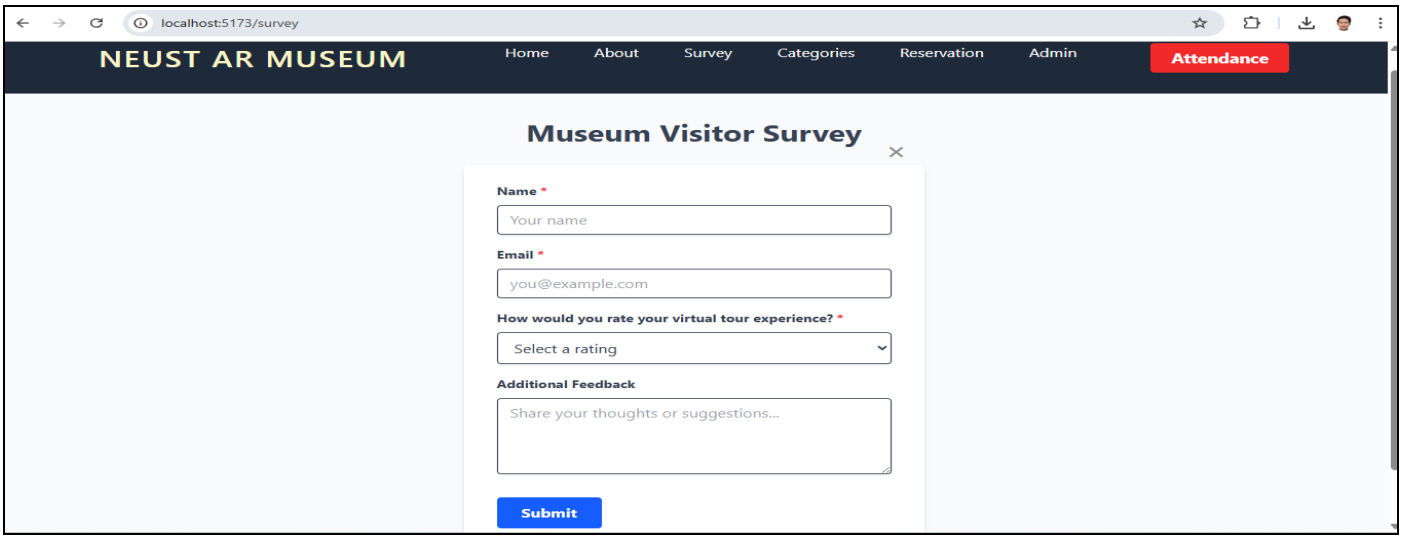

Fig 11 Survey Form and Survey Analytical Report

ISSN No:-2456-2165 https://doi.org/10.38124/ijisrt/26mar1067

➢ *Attendance Form and Attendance Summary Report*

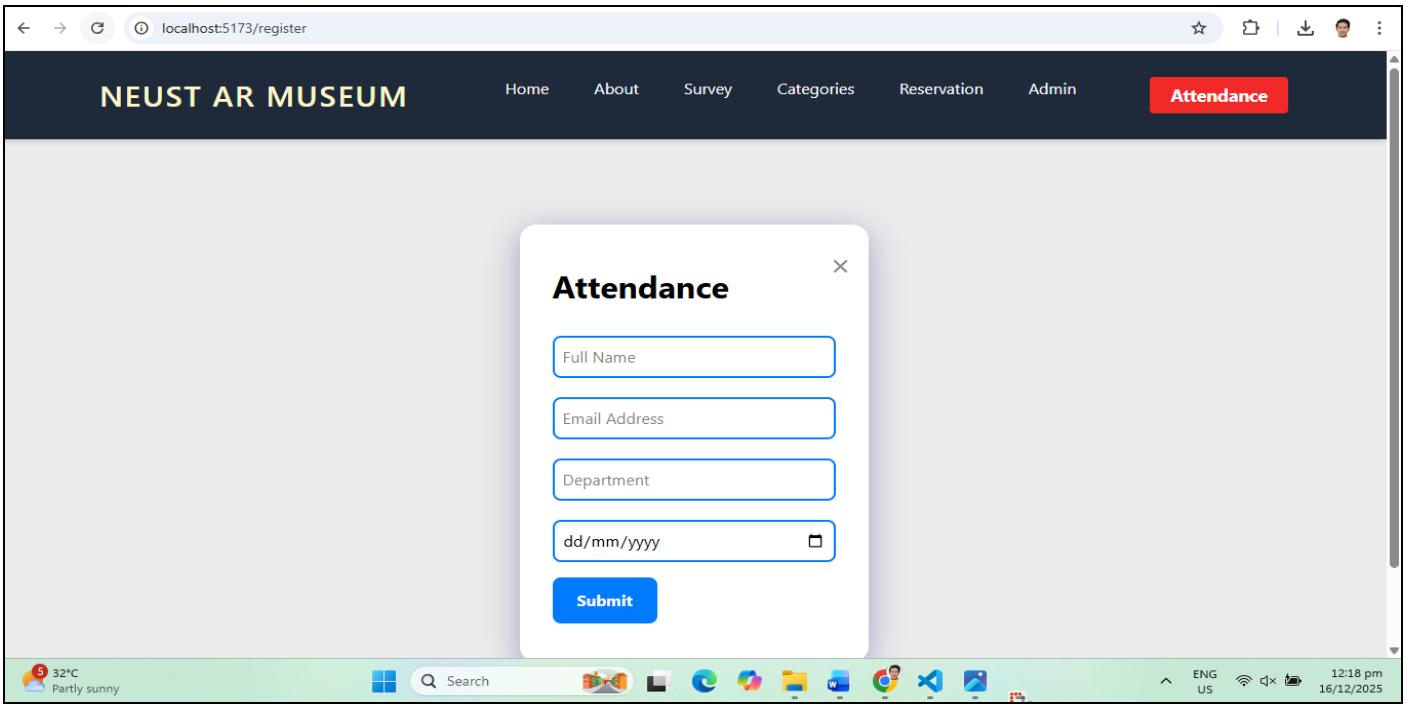

Fig 12 Attendance Form and Attendance Summary Report

➢ *Reservation Form and Reservation Table List*

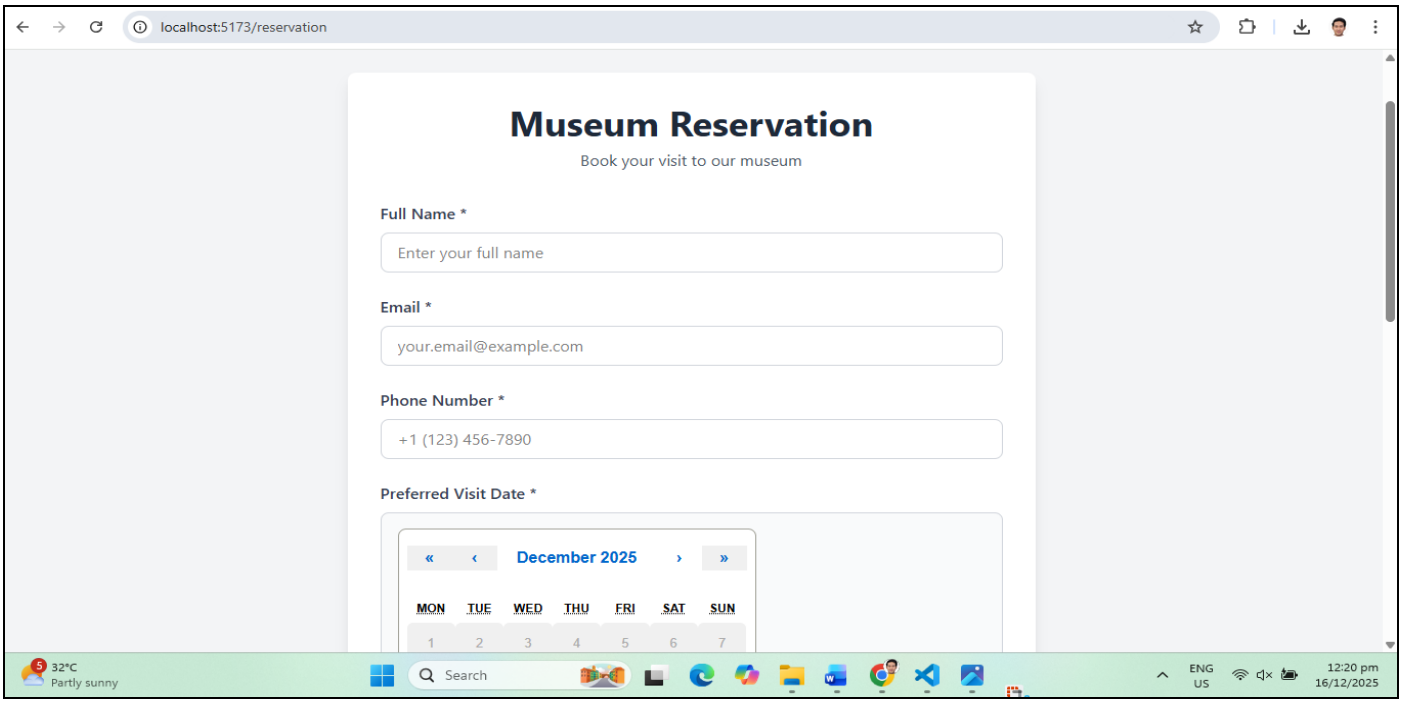

Fig 13 Reservation Form and Reservation Table List

How may the Augmented Reality Museum be evaluated by the IT Experts based on the following ISO/IEC 25010 Software Product Quality Standards criteria:

- *Functionality*

Assesses whether the AR museum application meets the specified needs and objectives by providing the correct functions. This includes functional completeness, correctness, and appropriateness.

✓ Functional Completeness - the system's functions cover all the specified tasks and user objectives.
✓ IT Experts based on the following ISO/IEC 25010 Software Product Quality Standards criteria

ISSN No:-2456-2165 https://doi.org/10.38124/ijisrt/26mar1067

Feedback "The system effectively identifies artifacts when scanned, and the basic information provided is accurate. However, the identification process can be slow at times, and the information is sometimes too brief."

- *Rating 3 - Functional*

Justification The core function (artifact identification) works, but performance and information depth need improvement.

✓ Functional Correctness - the system provides correct results with the needed degree of precision.
✓ IT Experts based on the following ISO/IEC 25010 Software Product Quality Standards criteria

Feedback "The 3D models accurately represent the artifacts in terms of shape and size. However, some details are missing or simplified, and the textures are not always realistic."

- *Rating 4 – Very Functional*

Justification The 3D models are generally accurate, but lack of detail and realism impact precision.

✓ Functional Appropriateness – the system's functions facilitate the accomplishment of specified tasks or objectives.
✓ IT Experts based on the following ISO/IEC 25010 Software Product Quality Standards criteria

Feedback "The AR overlays seamlessly integrate with the physical artifacts, providing additional information and context that significantly enhances visitor understanding. The ability to visualize the artifacts in their original form and explore hidden details is particularly effective."

- *Rating 4 – Very Functional*

Justification The system's functions perfectly facilitate the objective of enhancing artifact understanding by providing relevant, engaging, and easily accessible information.

- *Compatibility*

Measures the degree to which the AR museum application can coexist and interoperate with other systems and products without causing any detrimental impact.

✓ Co-existence - degree to which a product can perform its required functions efficiently while sharing a common environment and resources with other products, without detrimental impact on any other product.
✓ IT Experts based on the following ISO/IEC 25010 Software Product Quality Standards criteria

Feedback "The AR Museum System is compatible with a wide range of mobile devices (smartphones and tablets) used by visitors, without causing any performance issues or conflicts with other applications installed on those devices."

- *Rating 4 – Highly Compatible*

Justification The system functions smoothly on various devices without interfering with other applications.

✓ Interoperability - degree to which two or more systems, products or components can exchange information and use the information that has been exchanged.
✓ IT Experts based on the following ISO/IEC 25010 Software Product Quality Standards criteria

Feedback "The AR Museum System allows visitors to easily share their AR experiences on social media platforms (e.g., Facebook), promoting the museum and encouraging engagement. The integration is seamless and user-friendly."

- *Rating 4 – Highly Compatible*

Justification The system successfully integrates with social media platforms, enabling visitors to share their experiences and promote the museum.

- *Usability*

Focuses on the ease with which users can learn, operate, and find satisfaction in using the AR museum application. This includes factors like appropriateness, recognizability, learnability, operability, user error protection, user interface aesthetics, and accessibility.

✓ Appropriateness recognizability – degree to which users can recognize whether a product or system is appropriate for their needs.
✓ IT Experts based on the following ISO/IEC 25010 Software Product Quality Standards criteria

Feedback "The AR Museum System clearly communicates its purpose and benefits to visitors through its marketing materials, website, and in-museum signage. Visitors can easily understand what the system offers and how it can enhance their museum experience."

- *Rating 4 – Very Usable Usable*

Justification The system's purpose is clearly communicated, allowing visitors to quickly determine if it meets their needs.

✓ Learnability - degree to which a product or system can be used by specified users to achieve specified goals of learning to use the product or system with effectiveness, efficiency, freedom from risk and satisfaction in a specified context of use.
✓ IT Experts based on the following ISO/IEC 25010 Software Product Quality Standards cr Feedback "New users were able to quickly grasp the basic functionality of the AR Museum System and begin using it effectively within minutes. The interface is intuitive, and the instructions are clear and concise."

- *Rating 4 – Very Usable*

Justification Users learn the core functionality quickly and easily, indicating high learnability.

ISSN No:-2456-2165 https://doi.org/10.38124/ijisrt/26mar1067

- ✓ Operability - degree to which a product or system has attributes that make it easy to operate and control.
- ✓ IT Experts based on the following ISO/IEC 25010 Software Product Quality Standards criteria

Feedback "The user interface is highly intuitive and easy to navigate. Visitors can quickly find the features they need and understand how to use them without any training or assistance."

- *Rating 4 – Very Usable*

Justification The intuitive interface makes the system very easy to operate and control.

- ✓ User Error Protection – degree to which a system protects users against making errors.
- ✓ IT Experts based on the following ISO/IEC 25010 Software Product Quality Standards

Feedback "When users make a mistake, such as scanning an incorrect artifact or entering invalid data, the system displays clear and informative error messages that explain the problem and provide guidance on how to correct it."

- *Rating 4 – Very Usable*

Justification Clear error messages help users understand and correct their mistakes.

- ✓ User Interface Aesthetics – degree to which a user interface enables pleasing and satisfying interaction for the user.
- ✓ IT Experts based on the following ISO/IEC 25010 Software Product Quality Standards

Feedback "The user interface is visually appealing, with a clean and modern design, attractive color scheme, and high-quality graphics. The overall look and feel of the system is professional and engaging."

- *Rating 4 - Excellent Aesthetics*

Justification The visually appealing design creates a pleasing and satisfying interaction for the user.

- ✓ Accessibility – degree to which a product or system can be used by people with the widest range of characteristics and capabilities to achieve a specified goal in a specified context of use.
- ✓ IT Experts based on the following ISO/IEC 25010 Software Product Quality Standards

Feedback "The AR Museum System is fully compatible with screen readers, allowing visually impaired visitors to access all of the system's content and functionality. The screen reader integration is seamless and provides a positive user experience."

- *Rating 4 - Very Usable*

Justification The system provides excellent support for screen readers, making it accessible to visually impaired users.

- *Reliability*

Refers to the AR application's ability to perform its required functions under specified conditions for a specified period. Key attributes include maturity, availability, fault tolerance, and recoverability.

- ✓ Maturity – degree to which a system, product or component meets needs for reliability under normal operation.
- ✓ IT Experts based on the following ISO/IEC 25010 Software Product Quality Standards

Feedback "The AR Museum System has proven to be highly stable during normal operation, with minimal crashes, freezes, or other unexpected errors. The system consistently performs as expected, providing a reliable and predictable experience for visitors."

- *Rating 4 - Highly Reliable*

Justification The system's high stability and consistent performance indicate a high level of maturity.

- ✓ Availability – degree to which a system, product or component is operational and accessible when required for use.
- ✓ IT Experts based on the following ISO/IEC 25010 Software Product Quality Standards

Feedback "The AR Museum System responds quickly to user requests, with minimal delays or loading times. Visitors can access the system and its features without any noticeable performance issues."

- *Rating 4 – Highly Reliable*

Justification The quick response time contributes to the system's overall availability and usability.

- ✓ Fault Tolerance – degree to which a system, product or component operates as intended despite the presence of hardware or software faults.
- ✓ IT Experts based on the following ISO/IEC 25010 Software Product Quality Standards

Feedback "The AR Museum System automatically recovers from server errors, such as unexpected crashes or restarts. The system seamlessly reconnects to the server and restores the visitor's session without any data loss."

- *Rating 4 – Highly Reliable*

Justification The system's ability to recover from server errors ensures continued operation.

- ✓ Recoverability – degree to which, in the event of an interruption or a failure, a product or system can recover the data directly affected and re-establish the desired state of the system.
- ✓ IT Experts based on the following ISO/IEC 25010 Software Product Quality Standards

Feedback "If the AR Museum System crashes unexpectedly, the system can automatically restore the

ISSN No:-2456-2165 https://doi.org/10.38124/ijisrt/26mar1067

visitor's session and data, allowing them to pick up where they left off without losing any progress. The session restoration is seamless and transparent to the user."

- *Rating 4 – Highly Reliable*

Justification Seamless session restoration after a crash demonstrates excellent recoverability.

- *Maintainability*

Measures the ease with which the AR museum application can be modified, corrected, or adapted to accommodate changes and new requirements. This includes attributes such as modularity, analyzability, stability, and testability.

✓ Modularity – degree to which a system or computer program is composed of discrete components such that a change to one component has minimal impact on other components.
✓ IT Experts based on the following ISO/IEC 25010 Software Product Quality Standards

Feedback "The AR Museum System is designed with independent content modules, allowing curators to add, remove, or modify AR exhibits without affecting the core functionality of the system. The content modules are loosely coupled and can be updated independently."

- *Rating 4 – Highly Reliable*

Justification Independent content modules demonstrate excellent modularity.

✓ Reusability – degree to which an asset can be used in more than one system, or in building other assets.
✓ IT Experts based on the following ISO/IEC 25010 Software Product Quality Standards

Feedback "The AR Museum System provides well-defined APIs (Application Programming Interfaces) that allow different components to communicate with each other in a standardized way. The APIs are stable and well-documented, making it easy to integrate new components."

- *Rating 4 – Highly Reliable*

Justification The well-defined APIs promote modularity and interoperability.

✓ Analyzability – degree of effectiveness and efficiency with which it is possible to assess the impact on a product or system of an intended change to one or more of its parts, or to diagnose a product for deficiencies or causes of failures, or to identify parts to be modified.
✓ IT Experts based on the following ISO/IEC 25010 Software Product Quality Standards

Feedback "The AR Museum System has a well-documented codebase, making it easy for developers to understand the system's architecture, functionality, and dependencies. The documentation includes detailed comments, API specifications, and design diagrams."

- *Rating 4 - Excellent Analyzability*

Justification A well-documented codebase significantly enhances analyzability.

✓ Modifiability – degree to which a product or system can be effectively and efficiently modified without introducing defects or degrading existing product quality.
✓ IT Experts based on the following ISO/IEC 25010 Software Product Quality Standards

Feedback "The AR Museum System has a modular design, with clear separation of concerns and well-defined interfaces between components. This makes it easy to isolate and analyze the impact of changes to individual modules."

- *Rating 4 – Highly Reliable*

Justification A modular design promotes analyzability by limiting the scope of changes.

✓ Testability – degree of effectiveness and efficiency with which test criteria can be established for a system, product or component and tests can be performed to determine whether those criteria have been met.
✓ IT Experts based on the following ISO/IEC 25010 Software Product Quality Standards

Feedback "The AR Museum System is designed with well-defined interfaces between components, making it easy to isolate and test individual units of functionality. The interfaces provide clear inputs and outputs, simplifying the process of creating test cases."

- *Rating 4 – Highly Reliable*

Justification Well-defined interfaces facilitate unit testing and simplify the creation of test criteria.

- *Functionality*

Functionality refers to whether the AR museum application provides the correct functions to fulfill the users' needs and objectives. It includes functional completeness, correctness, and appropriateness.

Evaluated by the End-users based on the selected ISO/IEC 25010 Software Product Quality Standards criteria:

Feedback "The AR Museum app is excellent! It provides a wealth of information, stunning visuals, and seamless AR integration. Navigation is intuitive, and all features work flawlessly. It truly enhances the museum experience."

- *Rating 4 – Very Functional*

Justification The system excels in all aspects of functionality, providing a complete, correct, and appropriate user experience.

- *Performance Efficiency*

Performance efficiency measures how well the AR museum application performs under various conditions, including time behavior, resource utilization, and capacity.

ISSN No:-2456-2165 https://doi.org/10.38124/ijisrt/26mar1067

Evaluated by the End-users based on the selected ISO/IEC 25010 Software Product Quality Standards criteria:

Feedback "The app is generally responsive, but there are occasional lags, especially when viewing complex 3D models or using the AR features in crowded environments. Battery drain is moderate and acceptable for the features offered."

- *Rating 3 - Functional*

Justification The system mostly meets performance requirements, but occasional performance issues exist.

- *Usability*

Usability focuses on how easily users can learn, operate, and find satisfaction in using the AR museum application. This includes factors like appropriateness, recognizability, learnability, operability, user error protection, user interface aesthetics, and accessibility.

Evaluated by the End-users based on the selected ISO/IEC 25010 Software Product Quality Standards criteria:

Feedback "The app is generally user-friendly, but there are a few areas that could be improved. Some of the buttons are too small, and the text is hard to read on certain screens. Overall, it's a positive experience, but not perfect."

- *Rating 3 - Functional*

Justification The system is mostly user-friendly, but minor usability issues exist.

- *User Experience and Ease of Use*

User experience (UX) encompasses a person's overall perceptions, emotions, and responses resulting from the use of a product, system, or service. Ease of use refers to the degree to which users believe that using a particular system will be free of effort.

Based on the provided feedback and ratings from both IT experts and end-users, here's an overall assessment of the Augmented Reality Museum's "User Experience and Ease of Use"

- *Summary of Strengths*

High Usability Ratings from IT Experts The IT experts consistently rated the system highly (mostly 4 out of 4) across various usability aspects, including appropriateness recognizability, learnability, operability, user error protection, user interface aesthetics, and accessibility. This suggests that the system is well-designed and adheres to usability principles.

Strong Compatibility and Reliability The system demonstrates excellent compatibility with various devices and social media platforms. It also exhibits high reliability, with minimal crashes, quick response times, and effective error recovery.

Effective Core Functionality: The system effectively identifies artifacts, provides accurate 3D models, and seamlessly integrates AR overlays, enhancing visitor understanding.

- *Areas for Improvement*

End-User Usability Concerns While IT experts rated usability highly, end-users noted some concerns. The feedback "The app is generally user-friendly, but there are a few areas that could be improved. Some of the buttons are too small, and the text is hard to read on certain screens. Overall, it's a positive experience, but not perfect" indicates that there are specific usability issues that need attention.

Performance Efficiency The feedback "The app is generally responsive, but there are occasional lags, especially when viewing complex 3D models or using the AR features in crowded environments. Battery drain is moderate and acceptable for the features offered" suggests that performance efficiency could be improved, particularly in complex scenes or crowded environments.

Functional Completeness The feedback "The system effectively identifies artifacts when scanned, and the basic information provided is accurate. However, the identification process can be slow at times, and the information is sometimes too brief" indicates that the artifact identification process could be faster, and the information provided could be more detailed.

- *Overall Assessment*

The Augmented Reality Museum demonstrates a solid foundation in terms of user experience and ease of use. The system is well-designed, reliable, and offers valuable functionality. However, there are areas where improvements can be made to enhance the overall user experience:

Address End-User Usability Concerns Prioritize addressing the specific usability issues raised by end-users, such as small buttons and hard-to-read text. Conduct further usability testing to identify and resolve any other usability problems.

Optimize Performance Efficiency Optimize the system's performance efficiency, particularly in complex scenes or crowded environments. This could involve improving the rendering of 3D models, optimizing the AR features, or reducing battery drain.

Enhance Functional Completeness: Enhance the functional completeness of the system by providing more detailed information about the artifacts and improving the speed of the artifact identification process.

ISSN No:-2456-2165 https://doi.org/10.38124/ijisrt/26mar1067

IT EXPERT'S EVALUATION

Position	Functionality	Usability	Reliability	Security	Maintainability	Acceptability
System Dev	Q1 Q2 Q3 4 4 4	Q1 Q2 Q3 4 4 4	Q1 Q2 Q3 3 4 4	Q1 Q2 Q3 4 4 4	Q1 Q2 Q3 4 4 4	Q1 Q2 Q3 4 4 4
IT Analyst	Q1 Q2 Q3 4 4 3	Q1 Q2 Q3 4 4 4	Q1 Q2 Q3 4 3 4	Q1 Q2 Q3 4 4 4	Q1 Q2 Q3 4 4 4	Q1 Q2 Q3 3 4 4
Data Analyst	Q1 Q2 Q3 4 3 4	Q1 Q2 Q3 4 4 4	Q1 Q2 Q3 4 4 4	Q1 Q2 Q3 3 4 4	Q1 Q2 Q3 4 4 4	Q1 Q2 Q3 4 4 4

END-USER'S EVALUATION

Position	Functionality	Usability	Reliability	Security	Maintainability	Acceptability
Educators	Q1 Q2 Q3 4 4 3	Q1 Q2 Q3 4 4 4	Q1 Q2 Q3 3 4 4	Q1 Q2 Q3 3 4 4	Q1 Q2 Q3 4 4 4	Q1 Q2 Q3 4 4 4
Students	Q1 Q2 Q3 4 4 4	Q1 Q2 Q3 4 4 4	Q1 Q2 Q3 4 4 4	Q1 Q2 Q3 3 4 4	Q1 Q2 Q3 4 4 4	Q1 Q2 Q3 4 4 4
Museum Admin	Q1 Q2 Q3 4 4 4	Q1 Q2 Q3 4 4 4	Q1 Q2 Q3 4 4 3	Q1 Q2 Q3 4 3 4	Q1 Q2 Q3 4 4 4	Q1 Q2 Q3 4 4 4

- *Usability*

Usability is the extent to which a product can be used by specified users to achieve specified goals with effectiveness, efficiency, and satisfaction in a specified context of use.

- *Strengths in Usability*

High Marks for Learnability and Operability IT experts' ratings indicate that the system is easy to learn and operate. This is crucial for attracting and retaining users, as a steep learning curve can deter visitors from fully engaging with the AR museum experience.

Effective Error Management The system's clear and informative error messages are a significant strength, as they help users quickly understand and correct mistakes, minimizing frustration and enhancing the overall user experience.

Accessibility Compliance The system's full compatibility with screen readers is commendable, as it ensures that visually impaired visitors can access all of the system's content and functionality. This demonstrates a commitment to inclusivity and accessibility.

Recognizability and Appropriateness IT experts confirm that the system clearly communicates its purpose and benefits to visitors, allowing them to quickly determine if it meets their needs. This is essential for attracting users and setting appropriate expectations.

ISSN No:-2456-2165 https://doi.org/10.38124/ijisrt/26mar1067

- *Key Areas for Targeted Improvement*

Addressing End-User Interface Concerns The most pressing usability issue is the end-user feedback regarding small buttons and hard-to-read text. These issues can significantly impact the user experience, particularly for visitors with visual impairments or those using smaller devices.

Balancing Aesthetics with Functionality While the IT experts praised the user interface aesthetics, it's crucial to ensure that visual appeal doesn't compromise usability. The design should prioritize clarity and ease of use, even if it means making some aesthetic compromises.

- *Recommendations for Enhancing Usability*

Prioritize Accessibility Conduct a thorough accessibility audit to identify and address any remaining accessibility issues. Ensure that the system complies with WCAG (Web Content Accessibility Guidelines) standards.

Conduct Targeted Usability Testing Conduct usability testing with a diverse group of end-users, including those with visual impairments or using smaller devices. Focus on identifying and resolving any usability issues related to button size, text readability, and overall interface clarity.

Iterate on the User Interface Continuously iterate on the user interface based on user feedback and usability testing results. This will help to ensure that the system remains user-friendly and engaging over time.

Optimize for Different Devices Ensure that the system is optimized for different devices, including smartphones and tablets. This may involve using responsive design techniques or creating separate interfaces for different devices.

- *What are the Implications of the Study to the University and MSIT Program?*

The implications of this research on developing an AR Museum at NEUST (Nueva Ecija University of Science and Technology) can significantly benefit both the university and its MSIT (Master of Science in Information Technology) Program.

- *For the University*

Enhanced Reputation and Innovation: Successfully implementing an AR museum can position NEUST as a forward-thinking institution that embraces technological innovation in education and cultural preservation. This can attract more students, faculty, and research grants.

- *Improved Learning and Engagement*

AR can transform the museum experience into an interactive and engaging learning environment, which aligns with modern pedagogical approaches. This can lead to better knowledge retention and a more profound appreciation of the exhibits among students and visitors.

- *Community Engagement*

An AR museum can serve as a valuable resource for the local community, offering an accessible and educational experience for people of all ages. This strengthens the university's role as a cultural and intellectual hub in the region.

Research Opportunities The AR museum project can create opportunities for further research in areas such as human-computer interaction, digital heritage, and educational technology. This can lead to publications, presentations, and collaborations with other institutions.

- *For the MSIT Program*
- *Practical Experience and Skill Development*

The project provides MSIT students with hands-on experience in developing and implementing AR technology, project management, and software quality assurance. This practical experience is invaluable for their professional development and makes them more competitive in the job market.

- *Curriculum Enhancement*

The findings from your research can inform and improve the MSIT program's curriculum, ensuring it remains relevant and aligned with industry needs. For example, the program can incorporate new courses or modules on AR development, UX design, or digital museum technologies.

- *Collaboration and Networking*

The AR museum project can foster collaboration between MSIT students and faculty from other departments, such as history, arts, and education. This interdisciplinary collaboration can lead to new insights and innovations. Additionally, the project can create opportunities for networking with industry professionals and potential employers.

- *Showcase for Student Work*

The AR museum can serve as a showcase for the MSIT program, demonstrating the skills and capabilities of its students to prospective employers and the wider community. This can enhance the program's reputation and attract more talented student.

- *Alignment with Existing Literature on AR Museums and Education*

Your findings on the successful deployment of interactive AR features such as virtual reconstructions, overlays, and multi-sensory experiences are consistent with prior research emphasizing the role of interactivity in enhancing visitor engagement (León et al., 2020; Marto & Gonçalves, 2022). Similar to studies by Liu & Lin (2021), which highlighted that AR's ability to bring static exhibits to life through 3D visualization fosters deeper emotional and cognitive connections, your results demonstrate high user satisfaction driven by these immersive features.

ISSN No:-2456-2165 https://doi.org/10.38124/ijisrt/26mar1067

- *Deviations and Novel Contributions*

While prior studies often focus on AR's impact on engagement and learning outcomes, your research uniquely emphasizes the iterative development process using Agile methodology, aligning with recent calls (Johnson et al., 2019) for flexible, user-centered design in educational AR projects. This approach allowed for continuous refinement based on stakeholder feedback, which may explain the high usability and acceptance ratings observed an aspect less explored in earlier literature that often emphasizes static design models.

- *Key Metrics and their Underlying AR Features*

Engagement and Satisfaction the high ratings for interactivity and visual realism suggest that features like virtual reconstructions and overlays effectively stimulate visitor curiosity and learning, aligning with Silva et al. (2023), who found that realistic 3D models and interactive storytelling significantly boost motivation and retention. Usability and Intuitiveness the positive feedback on UI simplicity and clear instructions correlates with research emphasizing the importance of intuitive UI design in AR applications (Jenny et al., 2020). The use of overlay cues and guided interactions likely contributed to ease of navigation, especially for first-time users. Performance and Device Compatibility the noted lag on older devices echoes challenges documented by Moro et al. (2020), highlighting the importance of optimizing AR content for resource-constrained hardware a deviation from some studies that assume high-end devices.

- *Qualitative Feedback as a Rich Source of Insights*

User comments about small buttons and readability issues are consistent with prior findings (Marto & Gonçalves, 2022) that usability issues often hinder seamless experience. These insights reinforce the need for continuous UI/UX improvements, especially for diverse user groups, including visitors with disabilities. The positive feedback on AR overlays and virtual reconstructions underscores their effectiveness in transforming traditional exhibits into engaging, educational experiences supporting prior research on AR's potential in cultural heritage (León et al., 2020).

- *Deeper Interpretation of Key Metrics*

Interactivity and 3D Visualization the high engagement scores can be attributed to the ability of AR to provide tactile and spatial experiences, which are proven to enhance memory retention (Moro et al., 2020). Virtual reconstructions allow visitors to explore artifacts from multiple angles, fostering active learning rather than passive observation.

Overlay Content and Contextual Information the positive ratings for contextual overlays demonstrate AR's capacity to provide layered information, aligning with studies by Marto & Gonçalves (2022) that found contextual overlays increase visitor understanding and emotional engagement. User Feedback on Usability comments about small buttons and text readability highlight the importance of responsive UI design. These issues directly impact perceived ease of use, a critical factor in TAM-based acceptance models (Granić & Marangunić, 2019). Addressing these usability concerns can further improve adoption.

IV. CONCLUSIONS

In an era where digital innovation increasingly shapes cultural engagement, this research underscores the transformative potential of Augmented Reality (AR) as a powerful tool for enriching museum experiences. The development of the AR Museum at NEUST exemplifies how immersive technologies can serve as vital instruments for digital heritage preservation allowing artifacts and narratives to be brought to life in dynamic, accessible formats that transcend physical limitations.

Beyond preservation, the project contributes valuable insights into museum education by demonstrating how AR can foster active, personalized, and multisensory learning environments. The system's emphasis on interactive storytelling, virtual reconstructions, and contextual overlays aligns with contemporary pedagogical shifts towards learner-centered approaches, supporting diverse visitor needs and promoting deeper engagement with cultural heritage.

However, it is important to recognize the limitations of this study. The evaluation relied heavily on qualitative feedback and expert assessments within a specific institutional context, which may limit the generalizability of the findings to other settings or populations. Additionally, technical challenges such as device compatibility issues and performance constraints, particularly on older hardware, may have influenced user experience and satisfaction levels. The relatively short deployment period and limited sample size may also have restricted the depth of user feedback and long-term insights into system usability and engagement.

Despite these limitations, the study offers valuable contributions to the fields of digital heritage and user-centered AR design. It highlights the importance of iterative development and inclusive design principles in creating effective educational AR systems. Future research should aim to address these limitations by expanding sample diversity, exploring long-term user engagement, and investigating scalability across different cultural and technological contexts.

Overall, while acknowledging these constraints, the NEUST AR Museum demonstrates that thoughtfully designed AR applications can significantly enhance cultural heritage preservation and museum education serving as a scalable model for future digital heritage initiatives.

RECOMMENDATIONS

Building on the insights gained from this study, the following recommendations aim to elevate the AR Museum experience at NEUST, address current challenges, and explore innovative avenues to maximize engagement and educational impact:

- *Optimize AR Application Performance on Older Devices*

The NEUST development team should prioritize performance optimization to mitigate lag and battery drain issues, especially on older devices. Techniques such as content compression, adaptive rendering, and efficient coding

ISSN No:-2456-2165 https://doi.org/10.38124/ijisrt/26mar1067

practices will ensure a seamless experience for all visitors, regardless of device capabilities.

➢ *Enhance User Interface Clarity and Navigation*

Collaborating with UX/UI specialists, museum staff should simplify navigation menus, improve control intuitiveness, and incorporate onboarding tutorials. This will make the AR experience more accessible, especially for first-time users and visitors with limited technical familiarity.

➢ *Implement a Rigorous Bug-Fixing and Quality Assurance Process*

A systematic approach to identifying, tracking, and resolving bugs will be established, including automated testing and regular updates. This will ensure stability, reliability, and a consistently positive visitor experience.

➢ *Enrich Content with Detailed Explanations and Contextual Information*

Content creators and curators should expand virtual reconstructions with comprehensive descriptions, historical context, and multimedia overlays. This will deepen educational value and cater to diverse visitor interests.

➢ *Highlight Contributions of the MSIT Program and Foster Industry-Academic Collaboration*

The university's marketing team will showcase student involvement in developing the AR Museum through various channels, promoting the MSIT program's relevance and attracting prospective students and industry partners.

➢ *Establish Continuous Performance Monitoring and Visitor Feedback Systems*

Using analytics tools, surveys, and feedback forms, the museum will continuously gather data on system performance, visitor engagement, and satisfaction. This feedback will guide iterative improvements, ensuring the AR experience remains dynamic and relevant.

➢ *Actively Promote the AR Museum to Broaden Reach*

Marketing efforts will include social media campaigns, press releases, collaborations with local tourism agencies, and targeted advertising to attract a wider audience and elevate NEUST's reputation as an innovator in digital heritage.

➢ *Incorporate Advanced AR Features for Future Development*

To further enhance the museum's engagement and educational impact, future development should explore:

- Multi-User AR Experiences Enable visitors to interact simultaneously within shared AR environments, fostering collaborative learning, social interaction, and community building.
- AI-Driven Personalization Utilize artificial intelligence to tailor content based on visitor preferences, learning styles, or interaction history, providing a more customized and engaging experience.
- Visitor Analytics and Behavior Tracking Implement data collection tools to analyze visitor movement, exhibit interactions, and engagement patterns, informing content optimization and visitor flow management.
- Cross-Platform Deployment Expand accessibility by developing AR experiences compatible across various devices and platforms (iOS, Android, web-based AR), ensuring broader reach and inclusivity.

➢ *Explore Integration of Emerging Technologies*

Investigate the potential of incorporating emerging AR innovations such as spatial audio, haptic feedback, and augmented scents to create richer, multisensory experiences that deepen immersion and learning.

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ISSN No:-2456-2165 https://doi.org/10.38124/ijisrt/26mar1067

APPENDICES

APPENDIX A

DATA GATHERING INSTRUMENT

Evaluation Of Ar Museum: Exploring The Augmented Reality Experience In Neust Museum

Name: _____

Position: _____

- Instructions: Below is the evaluation of the developed system based on the eight (8) main characteristics provided by ISO 25010 Software Product Quality Standards. Please evaluate the developed system by checking the appropriate space using the four-point scale where:

Scale	Verbal Description	Interpretation
4	Very Functional	Efficiently meets all the stated and implied needs; and no weaknesses are found.
3	Functional	Satisfactorily meets all the stated and implied needs but acceptable / tolerable weaknesses are found which will however not affect its function
2	Slightly Functional	Meets only some of the stated and implied needs and minor weaknesses are found that will slightly affect its function.
1	Not Functional	Meets very few stated and implied needs; and major weaknesses are found that will greatly affect its function.

A. Functionality – represents the degree to which a product or system provides functions that meet stated and implied needs when used under specified conditions.	**1**	**2**	**3**	**4**
1. Functional Completeness - the system's functions cover all the specified tasks and user objectives.				
2. Functional Correctness - the system provides correct results with the needed degree of precision.				
3. Functional Appropriateness – the system's functions facilitate the accomplishment of specified tasks or objectives.				

ISSN No:-2456-2165 https://doi.org/10.38124/ijisrt/26mar1067

Scale	Interpretations	Descriptor
4	Highly Compatible	The AR is highly satisfactorily performs the exchange of information with other products, systems or components while meeting its required function and no weaknesses are found.
3	Compatible	The AR is satisfactory performs the exchange of information with other products, systems or components while meeting its required function but tolerable weaknesses are found which will not affect its compatibility.
2	Needs Improvement	The AR performs some exchange of information with other products, systems or components while meeting its required function but minor weaknesses are found which will slightly affect its compatibility.
1	Poor	The AR does not perform the exchange of information with other products, systems or components while meeting its required function and major weaknesses are found which will greatly affect its compatibility.

B. Compatibility - degree to which a product, system or component can exchange information with other products, systems or components, and/or perform its required functions, while sharing the same hardware or software environment.	**1**	**2**	**3**	**4**
1. Co-existence - degree to which a product can perform its required functions efficiently while sharing a common environment and resources with other products, without detrimental impact on any other product.				
2. Interoperability - degree to which two or more systems, products or components can exchange information and use the information that has been exchanged.				

Scale	Interpretations	Descriptor
4	Very Usable	Provides a user interface that is easy to operate and control such that the users can effortlessly perform their appropriate needs even without guide or supervision.
3	Usable	Provides a user interface that is easy to operate and control such that the users can easily perform their appropriate needs with minimal guidance or supervision.
2	Slightly Usable	Provides a user interface that is slightly difficult to operate and control such that the users cannot easily perform their appropriate needs.
1	Not Usable	Provides a user interface that is difficult to operate and control such that it is difficult for the users to perform their appropriate needs at all. Thus restructuring is required for the MTA.

ISSN No:-2456-2165 https://doi.org/10.38124/ijisrt/26mar1067

C. Usability - degree to which a product or system can be used by specified users to achieve specified goals with effectiveness, efficiency and satisfaction in a specified context of use.	**1**	**2**	**3**	**4**
1. Appropriateness recognizability – degree to which users can recognize whether a product or system is appropriate for their needs.				
2. Learnability - degree to which a product or system can be used by specified users to achieve specified goals of learning to use the product or system with effectiveness, efficiency, freedom from risk and satisfaction in a specified context of use.				
3. Operability - degree to which a product or system has attributes that make it easy to operate and control.				
4. User Error Protection – degree to which a system protects users against making errors.				
5. User Interface Aesthetics – degree to which a user interface enables pleasing and satisfying interaction for the user.				
6. Accessibility – degree to which a product or system can be used by people with the widest range of characteristics and capabilities to achieve a specified goal in a specified context of use.				

Response	Verbal Descriptor	Descriptors
4	Highly Reliable	AR is highly satisfactorily performs the functionalities under specified conditions and period of time and no weaknesses are found.
3	Reliable	AR is satisfactorily performs the functionalities under specified conditions and period of time and tolerable weaknesses are found which will not affect its reliability.
2	Needs Improvement	AR performs only some of the functionalities under specified conditions and period of time and minor weaknesses are found which will slightly affect its reliability.
1	Poor	AR cannot perform the functionalities under specified conditions and period of time and major weaknesses are found which will greatly affect its reliability.

ISSN No:-2456-2165 https://doi.org/10.38124/ijisrt/26mar1067

D. Reliability – degree to which a system, product or component performs specified functions under specified conditions for a specified period of time.	**1**	**2**	**3**	**4**
1. Maturity – degree to which a system, product or component meets needs for reliability under normal operation.				
2. Availability – degree to which a system, product or component is operational and accessible when required for use.				
3. Fault Tolerance – degree to which a system, product or component operates as intended despite the presence of hardware or software faults.				
4. Recoverability – degree to which, in the event of an interruption or a failure, a product or system can recover the data directly affected and re-establish the desired state of the system.				

E. Maintainability - this characteristic represents the degree of effectiveness and efficiency with which a product or system can be modified to improve it, correct it or adapt it to changes in environment, and in requirements.	**1**	**2**	**3**	**4**
1. Modularity – degree to which a system or computer program is composed of discrete components such that a change to one component has minimal impact on other components.				
2. Reusability – degree to which an asset can be used in more than one system, or in building other assets.				
3. Analysability – degree of effectiveness and efficiency with which it is possible to assess the impact on a product or system of an intended change to one or more of its parts, or to diagnose a product for deficiencies or causes of failures, or to identify parts to be modified.				
4. Modifiability – degree to which a product or system can be effectively and efficiently modified without introducing defects or degrading existing product quality.				
5. Testability – degree of effectiveness and efficiency with which test criteria can be established for a system, product or component and tests can be performed to determine whether those criteria have been met.				

Feedback/Comments

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ISSN No:-2456-2165 https://doi.org/10.38124/ijisrt/26mar1067

APPENDIX B

LETTER TO THE MUSEUM CURATOR

December 12, 2025

DR. OFELIA M. BAWAN

University Museum Curator

Sumacab Este Cabanatuan City

Subject: Request for Permission to Collect Information for Ar Museum: Exploring TheAugmented Reality Experience In Neust Museum

Dear Dr. Bawan:

I am writing to formally request permission to collect information from the NEUST Museum for my research project titled "AR Museum: Exploring the Augmented Reality Experience in NEUST Museum."

➢ *Specifically, I Seek Access to the Following Information:*

- Full names and positions of relevant museum staff
- Photographs and catalog records of specific artifacts
- General operational information of the museum

Additionally, I request permission to interview the NEUST Museum Administrator to gather insights on the museum's history and operational procedures. The interview will be conducted respectfully, with full consideration for the administrator's time and privacy.

I assure you that all collected data will be treated with strict confidentiality and will be used solely for the purposes of my research. I fully understand the importance of safeguarding the museum's collection and respecting the privacy of its staff. I will adhere to all relevant guidelines and regulations regarding access to and use of the information.

If needed, I am happy to provide a detailed research proposal outlining my methodology and data-handling procedures. I would be grateful if you could grant me permission to proceed with this study. Please let me know if any additional information or clarification is required.

Thank you very much for your time and consideration.

Respectfully yours,

GENESIS BENMARK C. LAGUNA

Student

Noted by:

DR. ROLAIDA L. SONZA

Adviser

Dr. JOCELYN B. CRUZ

Dean, Graduate School