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Unlocking Heritage in Virtual Reality: A Public Engagement Tool for Tourism and Remote Education in Bangladesh

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Abstract

This article explores the potential of Virtual Reality (VR) as a transformative tool for engaging the public with Bangladesh's cultural heritage. By integrating immersive technologies into tourism and remote education, VR can enhance the accessibility, interpretation, and preservation of historical sites and traditions. Specifically, we focus on the application of VR in Bangladesh, where many cultural heritage sites are either physically inaccessible or lack comprehensive educational resources. VR offers an innovative approach to overcoming these barriers while promoting public engagement in both tourism and education sectors.

Introduction

Bangladesh, with its rich resource of cultural heritage, is home to ancient temples, mosques, and historical sites that are vital to its national identity. However, many of these heritage sites remain underutilized as public engagement tools due to inaccessibility, limited resources for physical preservation, and inadequate educational dissemination. Virtual Reality (VR) has emerged as a new frontier for enhancing access, preserving cultural artifacts, and creating interactive learning environments. This article examines how VR can serve as a powerful tool for public engagement, fostering tourism and remote education. By digitally recreating heritage sites and providing immersive experiences, VR enables people to explore, learn, and interact with history in innovative ways, whether from home, school, or tourist venues. This shift could help Bangladesh transform its tourism industry and significantly boost educational engagement, particularly for those unable to access these sites physically. A survey involving 300 participants—including students, teachers, researchers, and professionals—evaluates the reception of a VR model of the Chhoto Sona Mosque. The results highlight high satisfaction levels and a willingness to adopt VR for both learning and exploration, solidifying its role as a pivotal innovation in cultural heritage preservation and education.

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The Role of Virtual Reality in Heritage Tourism

Tourism is a crucial industry for many countries, contributing significantly to economic growth. In Bangladesh, heritage tourism has untapped potential, but limitations, such as infrastructural challenges and remote locations of many heritage sites, have hindered its development. VR can bridge this gap by offering tourists an immersive experience of cultural sites from anywhere in the world.

Enhancing the Tourist Experience:

VR can create immersive virtual tours of heritage sites, allowing users to experience these locations in ways previously unimaginable. A virtual walk through the ruins of the Mahasthangarh, the historic mosque of Bagerhat, the Gem of ancient Gaur: Chhoto Sona Mosque or the intricacies of Paharpur can provide tourists a realistic view without the limitations of distance, cost, or physical barriers. Through VR headsets or even web-based platforms, tourists can access detailed, interactive visualizations of these sites, boosting international engagement and domestic awareness of Bangladesh's cultural heritage.

Promoting Virtual Tourism for Accessibility

In addition to traditional tourism, VR opens up the possibility of 'virtual tourism', where visitors can experience heritage sites without physically being present. This model is particularly beneficial for those with physical disabilities, elderly populations, or individuals restricted by travel constraints. By promoting VR-based heritage tourism, Bangladesh can target new demographics, increasing global visibility and cultural appreciation.

Virtual Reality in Remote Education

As educational institutions worldwide move toward digital learning, remote education is becoming increasingly vital. VR has the capacity to revolutionize how

Step into the Past: Experience History Through VR with a 'Past View' Button

students engage with historical knowledge, especially in regions like Bangladesh, where many heritage sites are difficult to access for field trips or physical exploration due to factors such as cost, distance, age, and other limitations.

Immersive Learning Experiences

Incorporating VR into history and cultural studies curricula can provide students with immersive, hands-on learning experiences. Rather than reading about historical sites, students can virtually 'walk through' ancient cities, interact with 3D-rendered artifacts, and experience historical events in real-time. This approach can deepen their understanding of history and culture and make learning more engaging, particularly for students in remote areas who may not have easy access to museums or historical sites. We have made a VR model of Chhoto Sona Mosque for

Step into the Virtual Platform and explore like never before ((AI Generated image)

immersive learning experience. As part of the virtual conservation of the Chhoto Sona Mosque through geometric modeling after the completion of the line drawing work, each design, color and other elements such as doors, arches, domes, etc. have been made to a certain size.[1] This model is accessible via any smartphone, computer, or VR headset with an internet connection. Simply scan the QR code below or visit the link (https://setvertex.org/vr/) to explore the Chhoto Sona Mosque virtually with ease.

1. F. Hou, Y. Qi, X. Shen, S. Yang, Q. Zhao, 'Automatic registration of multiple range images based on cycle space', *The Visual Computer: International Journal of Computer Graphics (5),* 2009, pp. 657-665

Expanding Access to Education

One of the key barriers to education in Bangladesh is geographical and socioeconomic disparity. VR can democratize access to cultural knowledge by offering educational programs that allow students to virtually visit historical landmarks from the classroom or their homes. This is especially relevant in remote regions where traveling to historical sites is difficult or costly. Furthermore, VR can be integrated with existing digital platforms for remote education, enhancing the educational infrastructure.

Figure 1: QR Code of VR Model

Public Engagement and Cultural Preservation

Creating Virtual Archives for Preservation

One of the primary advantages of VR is the ability to digitally preserve cultural heritage that may be at risk due to natural disasters, urbanization, or neglect.[2] By creating virtual archives of heritage sites, Bangladesh can ensure that future generations have access to their cultural heritage, even if the physical sites are compromised. 3D models, scans, and historical recreations can serve as long-term digital records for conservation and education.[3]

4.2 Engaging a Global Audience

VR not only provides access for local populations but also engages a global audience. With heritage sites being made available through virtual platforms, international researchers, students, and tourists can explore Bangladesh's cultural history without traveling. This can promote cross-cultural

2. A. H. Dani, *Muslim Architecture in Bengal*, Dhaka, 1961, p. 15
3. C. Wee, K. M. Yap, W. N. Lim, *iProgVR: Design of a Virtual Reality Environment to Improve Introductory Programming Learning*, IEEE Access: Piscataway, NJ, USA, 2022, Volume 10, pp. 100054-100078.

understanding and create opportunities for collaborative research on cultural preservation.[4]

Survey Methodology

A structured survey was conducted with 350 participants from various demographics:

- 100 Students: Primarily from history and archaeology departments.
- 30 Teachers: Representing secondary and tertiary education.
- 70 Researchers: Focused on heritage studies, archaeology, and cultural preservation.
- 50 Corporate Professionals: Primarily from tech and tourism sectors.
- 100 General Public: Enthusiasts of cultural heritage.

Participants explored the VR model of the Chhoto Sona Mosque, accessible via a smartphone or VR headset, and answered questions about their experience. Data was collected on usability, educational value, and potential applications.

Survey Insights

Overall Satisfaction

- 85% reported being 'very satisfied' with the VR model experience.
- 10% found it 'satisfactory'.
- 5% suggested improvements, particularly regarding enhanced interactivity.

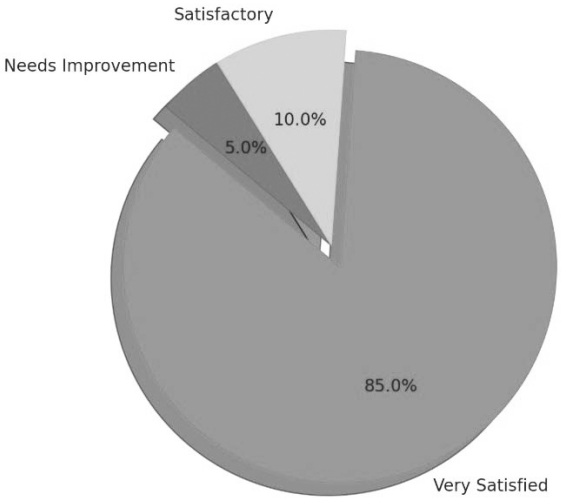
Usability

- 90% found the model easy to navigate on a smartphone.
- 75% appreciated its compatibility with low-speed internet, which was a key factor for participants in rural areas.
- 65% mentioned they used mid-range smartphones without any performance issues.

Educational Value

- 70% of students (245) felt the VR model enhanced their understanding of the Chhoto Sona Mosque's architecture.
- 30% of them expressed interest in incorporating VR into their lessons.
- 65% of researchers considered the VR model a useful tool for studying and preserving heritage.

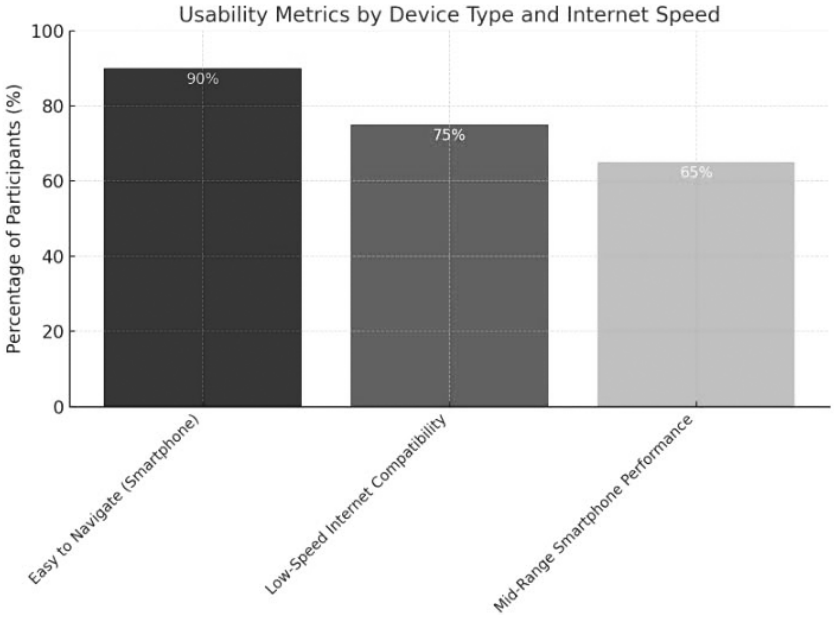
4. B. Kitchenham, *Procedures for Performing Systematic Reviews*, Volume 33, Keele University: Keele, UK, 2004



The pie chart displaying the overall satisfaction levels with the VR model experience

Tourism and Public Engagement

- 60% of corporate professionals highlighted VR's potential to boost virtual tourism.

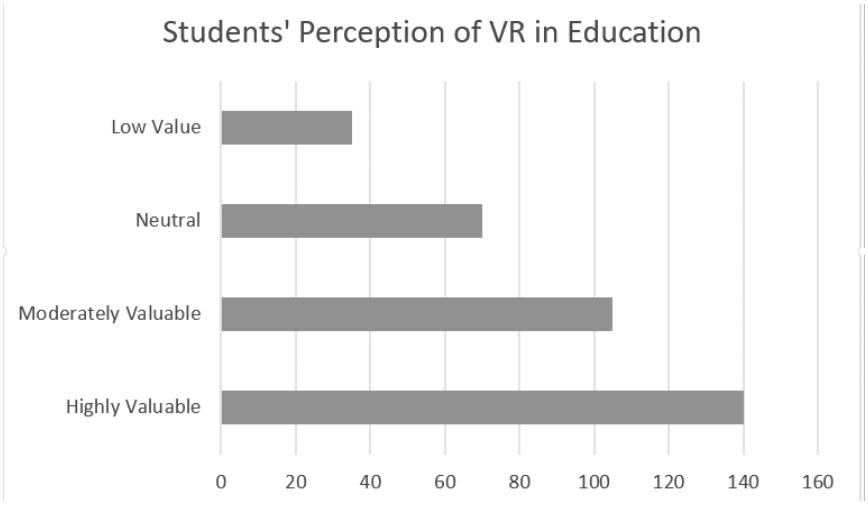


The bar chart comparing usability metrics by device type and internet speed

- 90% of general public participants agreed that VR could improve accessibility to heritage sites for those unable to travel physically.

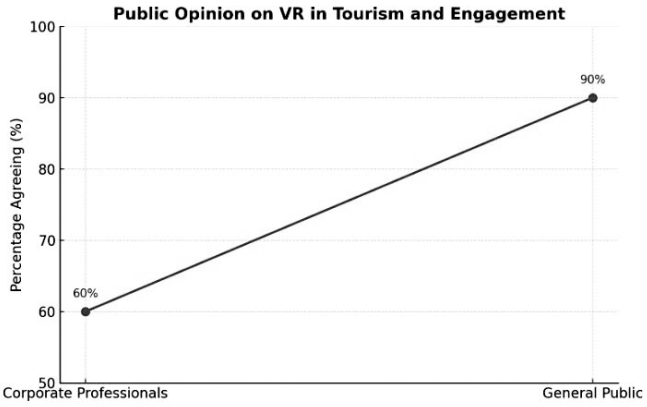
Survey Results: Insights and Implications

The survey findings underline the effectiveness of the VR model in achieving its objectives. Its compatibility with common devices and low-bandwidth internet makes it accessible to a wide audience, addressing a significant challenge in digital



The stacked bar chart displaying the perceived educational value of the VR model across students, teachers, and researchers

heritage applications within Bangladesh. For students, the VR model provided an immersive supplement to traditional learning methods. Teachers and researchers emphasized its role in fostering a deeper appreciation of heritage, making history



The line graph showing public opinion trends on VR's potential in tourism and engagement

tangible and interactive. Corporate professionals recognized its commercial potential in promoting virtual tourism and creating new revenue streams.[5] The positive response from the general public underscores VR's ability to democratize cultural experiences, especially for underserved communities. By extending access to heritage education and tourism, VR creates a bridge between tradition and modernity.

Graphical Analysis

Satisfaction Levels across Demographics

Breakdown of satisfaction across the five participant groups highlights the universal appeal of the VR model.

Usability Metrics by Region

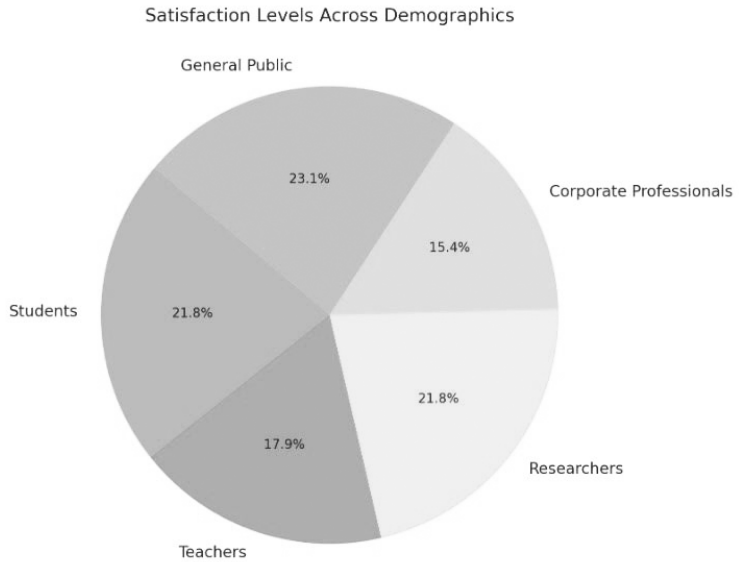
Illustrates how participants from rural and urban areas responded to the VR model based on internet speed and device compatibility.

Potential Applications

Lists key applications such as education, virtual tourism, and heritage preservation, with the percentage of respondents supporting each.

Educational Impact by Field

Compares the perceived educational value across students, teachers, and researchers.

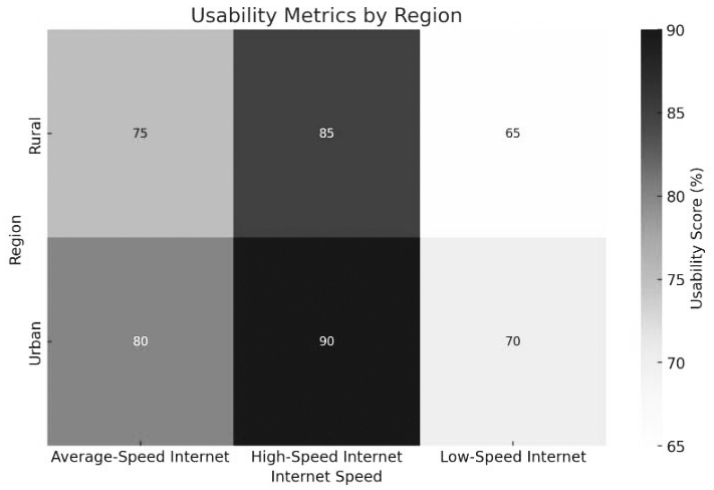


The pie chart illustrating satisfaction levels across different demographic groups

5. J. Pirker, I. Lesjak, C. Guetl, 'An educational physics laboratory in mobile versus room scale virtual reality—a comparative study', *Int. J. Online Eng. (Ijoe)*, 2017, pp. 106-120

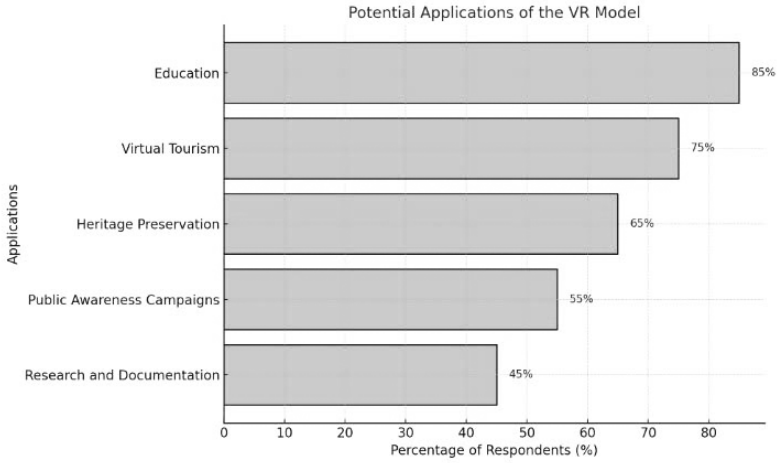
Challenges and Opportunities

The integration of Virtual Reality (VR) technology into heritage preservation presents a groundbreaking opportunity to showcase Bangladesh's rich cultural history. However, there are several technological barriers that must be addressed to maximize the impact of VR models in this field. Many areas in Bangladesh, especially rural



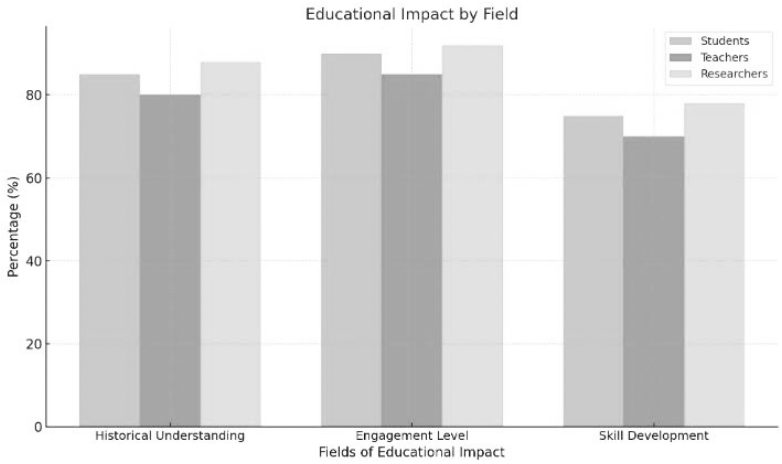
The heat map illustrating usability metrics by region based on internet speed

regions, suffer from inadequate internet connectivity. High-speed internet is a prerequisite for seamless VR experiences, as VR applications often require significant



The horizontal bar chart illustrating the potential applications of the VR model based on the percentage of respondents supporting each use case

bandwidth for streaming high-resolution 3D models and interactive features. Without reliable internet access, many users may face difficulties in accessing VR content. The cost of VR-compatible devices, such as VR headsets or high-performance smartphones, is a major challenge in a country where a significant portion of the population cannot afford such technology. Even mid-range devices, while capable



The grouped bar chart comparing the perceived educational value across students, teachers, and researchers in terms of historical understanding, engagement level, and skill development

of supporting some VR applications, may not deliver the optimal experience required for highly detailed models like the Chhoto Sona Mosque. Another barrier is the limited digital literacy among potential users. For many individuals, especially in rural and underserved communities, using advanced VR systems can be intimidating or confusing. This lack of familiarity with the technology might hinder widespread adoption and engagement. VR models, particularly those involving detailed architectural reconstructions, generate large file sizes. Efficient storage, distribution, and streaming of these files are dependent on robust data infrastructure, which is still underdeveloped in Bangladesh. Downloading or streaming such files can be slow and expensive for users with limited data plans. Frequent power outages and a lack of consistent electricity in many regions pose a challenge for using VR systems. Both the development and end-user application of VR technologies require reliable power sources, which are not always available in remote areas. The creation of VR models requires advanced technology, such as high-resolution 3D scanners, powerful rendering software, and skilled professionals. In Bangladesh, access to such resources and expertise is limited. Additionally, the cost of developing high-quality VR content can be prohibitive without sufficient funding and technical support. VR systems often

rely on text and audio for interaction, which may not always accommodate local languages or cultural nuances. Customizing VR experiences to reflect the linguistic and cultural diversity of Bangladesh requires additional investment and effort. Many stakeholders in the cultural heritage and tourism sectors may not yet recognize the potential of VR technology. Without adequate awareness and advocacy, there is limited impetus to invest in the infrastructure and skills necessary to develop and maintain VR projects. The initial costs of developing VR systems, creating high-quality content, and distributing the necessary hardware (e.g., VR headsets) can be prohibitive. Moreover, limited access to stable internet connections in rural areas may hinder widespread adoption of VR-based education and tourism.[6] Developing accurate, high-quality virtual representations of historical sites requires collaboration between historians, archaeologists, and technologists. Ensuring historical accuracy while maintaining an engaging experience can be a challenge.[7] However, partnerships between educational institutions, cultural experts, and tech companies can help mitigate these issues.

Policy and Funding:
Government support and funding will be crucial for implementing VR-based solutions at scale. Policies that encourage the development of digital heritage initiatives and public-private partnerships can accelerate the adoption of VR in both tourism and education.

Recommendations Based on Survey Findings

- Enhancing Interactivity: Incorporating features like interactive tours and quizzes to engage users further.
- Localization: Adding language options to broaden accessibility.
- Collaborations: Partnering with educational institutions and tourism boards for widespread adoption.
- Scaling Content: Expanding VR models to other heritage sites across Bangladesh.

Future Directions
The future of VR in heritage and education in Bangladesh looks promising. Expanding partnerships with tech companies, universities, and cultural organizations can further advance VR's capabilities. Innovations such as Augmented Reality (AR), AI-driven virtual experiences, and AI-assisted research on historical preservation are potential areas to explore.

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6. C. A. Steinkuehler, S. Duncan, 'Scientific habits of mind in virtual worlds', *J. Sci. Educ. Technol.*, 2008, pp. 530-543
7. S. Kavanagh, A. Luxton-Reilly, B. C. Wuensche, B. Plimmer, 'A systematic review of Virtual Reality in education', *Themes Sci. Technol. Educ.*, 2017, pp. 85-119

Integrating VR with tourism and education also presents significant opportunities for creating sustainable tourism models that emphasize cultural preservation and responsible travel.[8] The development of VR as an educational tool can help foster a more inclusive and accessible learning environment, ensuring that heritage sites are appreciated by a global audience for years to come.

Conclusion

The integration of VR into heritage preservation and education in Bangladesh has demonstrated transformative potential. Survey results highlight the widespread acceptance and enthusiasm for the VR model of the Chhoto Sona Mosque. By addressing accessibility, usability, and educational challenges, this initiative offers a roadmap for harnessing digital technology to celebrate and safeguard cultural heritage. Future projects can build on this foundation, advancing Bangladesh's position as a leader in innovative heritage conservation and digital education. Virtual Reality holds transformative potential for unlocking the cultural heritage of Bangladesh. As a tool for public engagement, it can significantly enhance both tourism and education by making heritage sites more accessible and interactive for a wider audience. Through VR, individuals can explore the rich history of Bangladesh, regardless of physical location or ability, thereby promoting cultural appreciation and preservation on a global scale. By embracing this digital technology, Bangladesh can lead the way in innovative heritage preservation and education, ensuring that its cultural treasures continue to inspire and educate future generations.

8. P. Mishra, M. J. Koehler, 'Technological pedagogical content knowledge: A framework for teacher knowledge', *Teach. Coll. Rec.*, 2006, pp. 1017-1054