

# Evaluating the perception of virtual reality in historical sites

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**Abstract:** Virtual reality (VR) has revolutionized the way we can experience historical sites, providing us with an immersive experience like never before. However, it is crucial to establish evaluation standards to ensure an authentic and engaging experience. This research solves the problem of evaluating perception in virtual reality of historical sites and demonstrates its effectiveness. The hypothesis of the research is clarified by identifying various indicators and factors, such as visual realism, accuracy of historical information, and creating interactive environments for visitors to achieve a realistic perception during their virtual experience of historical sites. The research aims to highlight the effectiveness of virtual reality in historical sites, and its importance in promoting economic tourism, education, documentation, and heritage preservation of buildings with both material and moral values. The historical site (Taq Kisra - Iraq) was chosen as a study area to apply the research indicators and demonstrate the validity of its hypothesis, creating a simulation of the building using 3D programs. After that, (30 samples) of visitors were selected in the applied aspect of the research, and the results of their responses to the virtual experience of the chosen site were counted during their virtual visit to it through a questionnaire that explained the importance of perception indicators for the response to virtual reality, to help us reach results that transport the virtual experience to an image closer to reality, achieving immersion and interaction Human. The results confirmed the importance of perception in virtual reality and depend on several indicators and factors. The most important of which are visual realism, sound design, interaction, and accuracy. The visual realism index is one of the most important factors affecting perception. The findings were statistically counted and graphically similar to it, reaching the rate of 87%. This led back to the most significant desired objective: achieving the isolation of perception in virtual reality experiences in historical sites. That aids in transmitting the past with realism and accuracy of information.

## 1 Introduction:

Preservation and presentation of cultural heritage have always been required in the historic places realm. But after the advent of technology, new ways are starting to provide new possibilities for us to improve our understanding and experience while practicing on these sites. One such method is the use of Virtual Reality (VR) to recreate historical environments and whisk us back in time. In virtual reality (VR), anything appears possible. VR completely changed our perspectives of gaming, education, and all we had known about interacting with our environment. Another interesting area through which VR has made great strides is in the exploration of historic sites. With virtual reality technology, the exploration of the world has become ever more realistic and one gets to know a lot about the past. Imagine being transported back in time and able to explore the ruins of a great empire or witness momentous events in history. Well, that could soon be made possible because due to advances in technology, virtual reality (VR) is now taking us to the most favorite historical sites without leaving our homes. However, to really be able to engage with these virtual worlds, it is important to set some benchmarks for the perception within VR. The present paper deals with criteria and indicators that give rise to a realistic and engaging VR experience at historic locations.

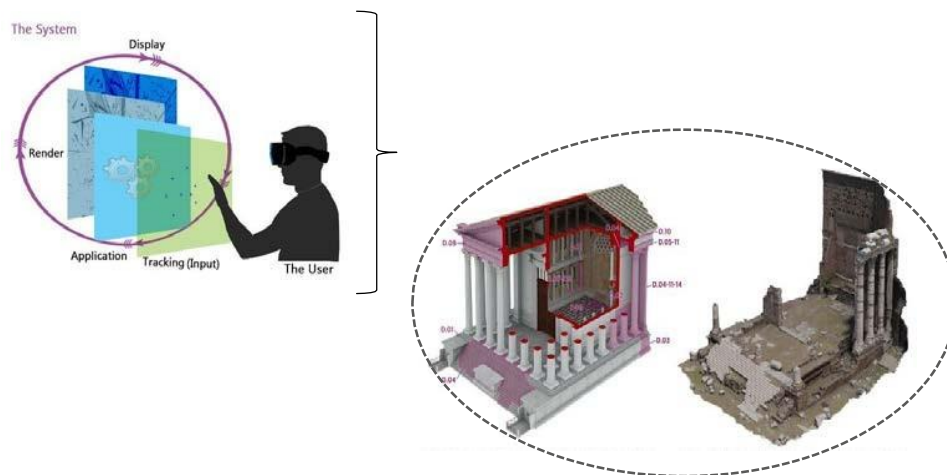
In this study, we will examine an interesting case study that sets examples of perceptive valuation in visual reality showing how VR can add value to our access to historical sites. We would look into the criteria of perception, the integration of VR in historical sites, and the pointers that formulate our perception in this virtual reality world.

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## 2 Virtual Reality(VR) In Historical Sites:

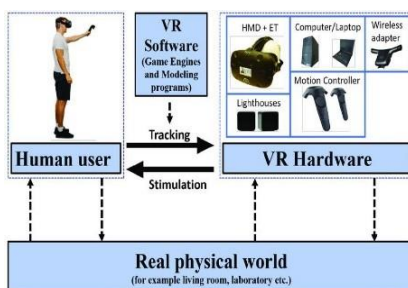
Historical sites are precious owing to their cultural and historical importance. Most often due to the physical restrictions, it is hard to feel or understand them fully. Virtual Reality (VR) proposes a solution via recreating these sites in virtual reality, and this allows us to get back in time and attempt them directly. Through the harboring of VR in historical sites, the gap between the present and past does get narrowed by supplying the visitor with an educational and attractive experience. It provides a visitor with a better and more personal feel that surpasses limits offered by traditional methods. Furthermore, given that VR is more accessible to a wider audience who may not necessarily have the opportunity to visit these sites in person, it makes history somewhat within their reach. With advanced technology, we could expect an increasing tendency to interact with realistic VR experiences that blur the line between the virtual and real depending on some factors that support the achievement of interactive immersive experiences promoting economic tourism and the cultural educational role of our societies, and most importantly, our antiquities' saving and knowing more about our history [1] see figure. 1.



defined the perception, the closer the virtual environment will stick to our experience in reality. However, this standard cannot be reached without committing attention to the precision of details, accurate architectural constructions, and sound impacts [4].

Information collected from a historic site has traditionally been obtained through our senses such as sound, sight, and touch. Nevertheless, senses are restricted due to physical

barriers and time limitations as well as a lack of seeing how the event is happening. Virtual Reality (VR) technology, on the other hand, would totally transcend the perception bounds. Attired with a VR headset, a user can go right up to every nook and corner of a historical site, talk to pseudo-characters, and even view a scene from history from all its possible angles. This immersability goes a much further way for a visitor to understand the site holistically and thus identify some of the details that probably are neglected when a visitor undertakes a physical visit. Experience Value: Valuation of perception in VR transcends mere visual replication. It includes the emotional and intellectual impact of an experience, too. By engaging in the virtual world we can feel what people felt that time used to feel while walking in the streets and this gives a better understanding of their lives and efforts. This emotive link instills enormous value into our perception as it provides us with the potential for personal association with history [5]. Additionally, VR has much higher values of interaction than traditional means. We will be able to investigate every corner and cranny, discover the hidden artifacts, and virtually interact with the historical personalities. Such interaction not just increases our imagination but also urges our active learning and exploration spirit. VR in Historical Sites: historical sites have great historical and cultural value, though physical limitations mostly hinder our exploration processes and understanding of these sites. VR offers a solution by reproducing these sites within a virtual space that enables us to get back in time and try them directly. With VR incorporated into historically recognizable sites, this can potentially be realized and hence bring the past closer to today's generation, supplying a better attractive, and educational incident for visitors [2].



### 2.3 .Indicators of Perception in VR:

Some of the indicators of perception to include in measuring VR effectiveness is the level of presence felt by users. Presence is the feeling of "being there" when experiencing a presence in a virtual environment. The more users feel present, the more it can be said that the experience is successful, immersive, and impacting. Different aspects can help increase presence, including realistic graphics, accurate spatial sounds, and user-friendly interfaces.

Another issue that is considered to be important is the emotional response caused by the virtual experience. VR can evoke stronger emotions than other media making a user feel empathic about the events and people of history. The ability of the VR experiences in historical places to shape a user's emotion through creating proper narratives with emotional cues helps create an intense tie between the present and the past [6].

Additionally, an essential element in perception is the level of interactivity. The activity evokes an extra sense of reality in the ability to maneuver and interact with significant wellbeing and control of things as well as the interaction with the historical people in course of the VR activity. The element of interactive learning, giving control is empowering, and as such, makes the user active in a particular historic narrative [1].

### 3 Methodology and Criteria:

When assessing the perception in VR for a historical site, one needs to look at different criteria and indicators. These factors will in turn offer an overall user experience while assessing the immersion level, and accuracy of historical events. The factors that should be considered are:

**Visual Realism:** Virtual environments have a significant impact on creating an authentic historical experience due to the quality of graphics, textures, and lighting. Reproducing historical sites realistically requires high-resolution textures, accurate lighting, and attention to detail.

**Audio Design:** This immersive experience is enhanced by sound effects, ambient noise, and accurate historical audio cues. It is important to synchronize the audio with the visuals to evoke a sense of presence and transport the user to the historical period.

**Interactivity:** User engagement in virtual environments is greatly influenced by their level of interactivity. The ability to interact with objects, engage in historical activities, and explore different paths enhances the overall experience and makes it more memorable.

**Historical Accuracy:** Authenticity is paramount when recreating historical sites in VR. Attention to historical accuracy, architectural details, and accurate depictions of artifacts and characters are crucial for delivering an educational and informative experience.

The research relied on an analytical methodology through several steps to prove its hypothesis, the first of which was analyzing previous experiments in which virtual reality and simulation were used in historical and heritage buildings, after that coming up with indicators to measure the effectiveness of perception in virtual buildings, then creating a three-dimensional model of the selected structures (Taq Kisra) and embodying it. Virtually to simulate the building in reality.

A questionnaire was conducted, which confirms in its content the indicators extracted previously, to test the effectiveness of those indicators for (30 samples) of people interested in this field, and to obtain results to demonstrate the validity of the research hypothesis and achieve the scientific goal.

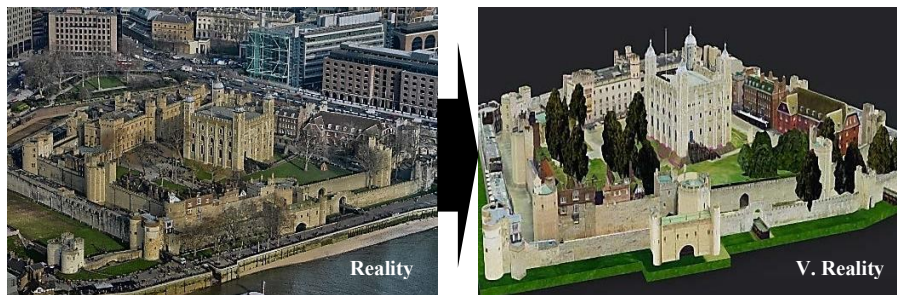
#### 3.1 The Impact of VR Technology on Perception of Historical Sites:

The Virtual Journey through Ancient Rome is a case study that illustrates the power of VR in historical sites. By wearing a VR headset, users can immerse themselves in the grandeur of the Roman Empire. They can walk through the bustling streets, admire the architectural wonders, and interact with virtual citizens of that era. This study focuses on the tangible influence of VR over our perception. Users relate that they had a stronger sense of presence, just like their walking in the ancient Rome streets [3]. This simulation also evoked increased interest and other positive feelings associated with history, including curiosity and awe [3]. Another study concentrated on the legendary Colosseum in Rome, and objective how VR inflects underpinning of our perception while visiting them personally. The Colosseum visitors are included in the study who visited it personally and attempted VR simulation of the same location. Detailed data on users' behavior were gathered involving eye-tracking technology, and user feedback. These enable the authors to meticulous analysis of various signs of perception: cognitive engagement, gaze patterns, and emotional responses [7].

Based on this investigation, both the VR simulation and the physical experience of the Colosseum prompted feelings of grandeur and awe. Nevertheless, more emotional reaction was produced in users privileged to experience the virtual environment due to the greater level of immersion and interaction provided. They can inspect concealed corners, connect with historical characters, and notice the Colosseum in its ex-glory. Furthermore, the study determined that VR enabled better memory. What made the experiment succeed was capturing history with its most intricate details starting from plazas and the terraces of the Colosseum. This created very high levels of interaction and immersion among the visitors enabling them to capture in some sense the spirit of the ancient city as if they were lived in it [7].

### 3.2 .Case Study:

**-The Tower of London:** Along centuries of history from royal ceremonies to gruesome executionsthis historical fortress witnessed all of that. VR technology has assisted researchers in introducingmuch-needed enhancements to the visitors' perception and understanding of the rich past of the Tower. To do this, some researchers built a virtual model of the Tower and made a deep reconstruction of its various premises, corridors as well as surrounding terrain. Visitors could latermove around the virtual Tower, communicate with its historical characters, and see all the events that took place within it. Thus, this experience lets visitors perceive the Tower in a fully new visionthat promotes a more profound link with its past. The spotlight was on the precise vision of the virtual Tower of London model that accurately simulates historical attributes, understanding history, and engaging with the past besides the sound impacts that anticipated the environments. Thus, through interaction and describing the experience in the virtual museum, they influence a deeper understanding of history and what the visitors follow [8] see figuer. 2.



**Fig. 2.**Show The Virtual of Tower of London ExperienceRef.: Wikipedia.com ,2023

The VR experience at the Tower of London exhibits some of the many innovations that through VR enhance can advantage history site experiences. By communicating the value of perception conveyed by VR, the visitors are able to [11]:

Obtain a deeper understanding of the site: with VR, visitors would be able to get deeper engaged in the historical context which leads to a deeper understanding of the site.

Detect the historical happenings: VR recreates the historical events giving a chance to witness them and learn their influence in an explicit manner.

Connect with the past: Virtual characters and interactive elements in VR experiences allow interaction with historical people for asking for information about their motivations and lives.

Overwhelm physical constraints: VR helps in breaking the physical confines as it makes these historic sites easily approachable for a person who has mobility or travel issues.

We can conclude the focus was on the precise vision of the virtual Tower of London model as well as the historical facts, history understanding, and interaction with the past, and the sound effects that foresee the environments. Their function is to get a deeper history understanding and observance of the visitors of the virtual museum through interaction and representing the experience.

**The Virtual Journey through Ancient City Rome Reborn:** In order to vividly illustrate the role of perception in Virtual Reality, let's analyze one of its outstanding examples: The Ancient City Rome Reborn. The main idea of the project is to reconstruct the ancient city of Rome that was lost for several long centuries. With modern VR technology, a team of archeologists, historians, and designers set out on the journey to revive this forgotten city. Based on extensive research of historical records, archaeological discoveries, and expert reasoning, the team recreated a virtual version of this city to ensure accuracy. They recreated the whole architecture of the city, its streets, and even the daily life and routine activity of the city inhabitants. The level of detailedness was astounding simply - from the heights of buildings to the textures on their walls or ambient sounds in busy markets [9] see figure. 3.

-The Impact of Perception for VR Rome:

The project of "Ancient City Reborn" exemplified how big the perception valuation in VR could be. It placed the users into a virtual reality-based experience where they felt like standing inside the city. Visitors could walk through the streets, meet virtual people, and have better insights into the history and culture of the city. Such experience left educated visitors filled in with emotions. As the participants walked through the virtual city many reported a sense of awe and wonder of connecting with the past in a way the traditional maps just cannot achieve. In this way, the VR perception was able to connect users at a more profound and personal level with the historic site. We conclude success of this case study opens exciting possibilities for the future of preserved and educational treatment of historic sites. VR technology could take us to any era allowing us the opportunity to experience historical events in real time and better appreciate our collective history [11].



Fig. 3. Show The Virtual of Ancient City Rome Reborn Experience Ref.: Wikipedia.com, 2023

**The Ruins of Pompeii:** An interesting example of the introduction of VR technology to improve our historical sites' perception is the ruins of Pompeii. For hundreds of years, this ancient city was under a layer of volcanic ash but thanks to modern technologies - especially virtual reality - now everyone can get an idea of how local residents within the city used to live. The detail level in the VR reconstruction of Pompeii is simply stunning, every street, every stone, and every fresco is accurate to the original design. By being involved in this virtual world, we will be able to

understand more about the history of the city and feel how magnificent it was centuries ago. Usually, VR enables one to travel in time backward and witness occurrences in a way that cannot be achieved through any other method. The application of Virtual Reality (VR) technology enables the environment to be immersive besides having stimulation for several senses at the same time. For instance, it is possible to feel the heat of the sun on your skin, and the noise of a bustling city and may get even a whiff of smells coming from ancient kitchens. Hence it is of extreme significance to feel and experience the same within the virtual world, i.e. value perception wherein this multi-sensory experience adds a layer of authenticity to it. However apart from visual replication, another value of perception in VR is the emotional and intellectual impact of the experience. When you are in the virtual world of Pompeii, you will feel the lives of the people who lived there. This kind of emotional connection, adds immense value to your perception, helps you establish a personal link with the history [10] see figure. 4.



**Fig. 4.**Show The Virtual of the Ruins of Pompeii ExperienceRef.: Wikipedia.com, 2023

What is more, interaction with this scale of virtual reality cannot be achieved in any other form of media. It simply enables us to explore every part and corner of Pompeii, discover concealed that is nestled in the ancient buried city, or even talk to people virtually from hundreds if not thousands of years ago. This interactive component not only enriches our understanding but also stimulates active learning and exploration [11].

We have reached the conclusion that visitors' interaction with a historical building and its details, through accurate and comprehensive analysis and transmission of historical information, along with the use of various senses to perceive the virtual environment, played a significant role in increasing the visitors' awareness of the environment. This resulted in them immersing themselves in it, as if they were transported back to the past of that period see table 1 below.

**Table 1.** Show The result of Case Studies ExperienceRef.: The Researcher, 2024

Case Studies	Visual Realism	Audio Design	Interactivity	Historical Accuracy
The Tower of London				
The ancient Rome				
The Ruins of Pompeii				

### 3.3 .The Importance of Standards Perception in Today:

Enhancing user confidence in virtual reality, which leads to building a base of users, those interested, and specialists in this field.

Encouraging economic movement and activating what is called (the globalized economy).3- Increasing efficiency and creating new innovations.

4- Addressing structural and environmental concerns and reducing the extinction of heritage.

## 4 Discussing the Results:

To gain a comprehensive understanding of the effectiveness of VR perception in historical sites, a case study was conducted. The study involved a group of participants who experienced a VR tour of a historical site. They were evaluated based on the aforementioned criteria, and their responses were recorded to gauge the overall effectiveness of the VR experience. The participants overwhelmingly reported a high level of immersion and engagement during the VR tour. The visual realism and attention to historical accuracy were particularly praised, with participants noting the stunning graphics and lifelike environments. The interactivity within the virtual environment was also highly regarded, as it allowed participants to actively engage with the historical site see figuer. 5.

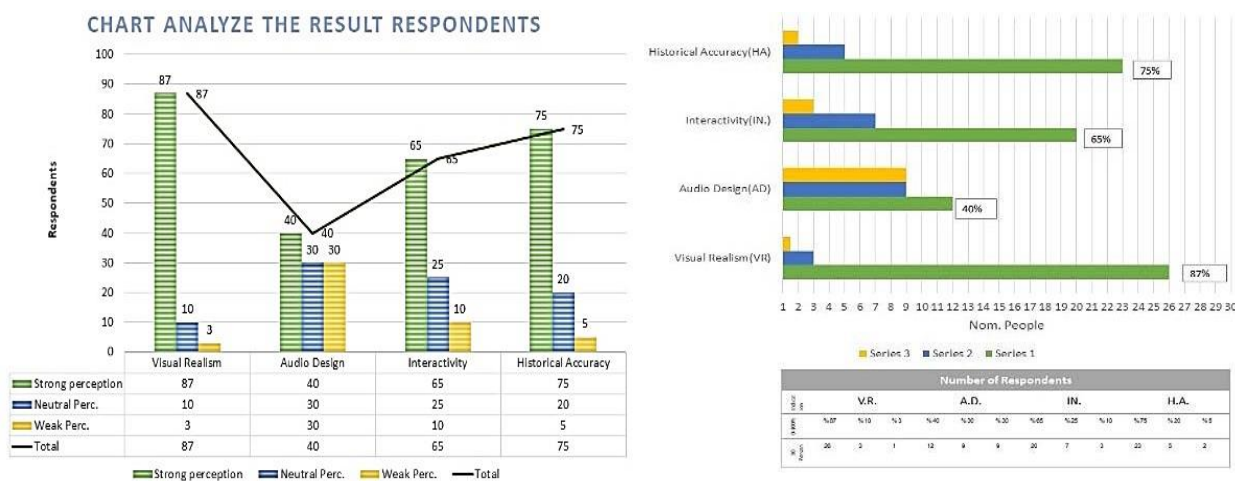
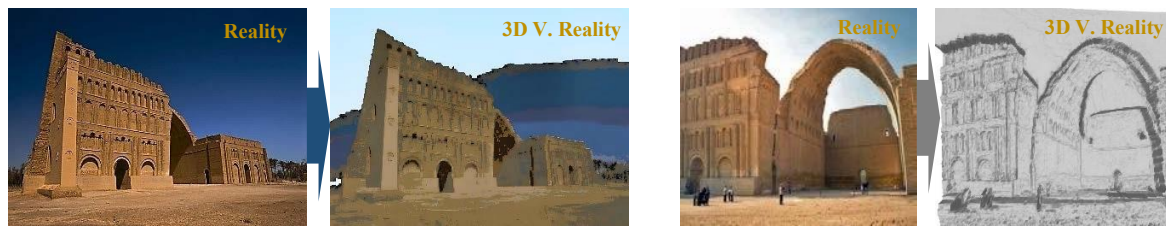


Fig. 5. Show The Charts of Result Questionnaire ExperienceRef.: The Researcher, 2024

The historical site of (**Taq Kisra**) was chosen as a case for this, as it was embodied virtually through special virtual programs because of its importance and control in the Iraqi cultural community and our keenness to shed light on it to document it virtually for its uniqueness with the advantage of containing the largest arch built of bricks in the world in the year 550 AD see figuer. 6.



**Fig. 6.**Show The 3D Study Area Experience / Taq Kisra-IRAQRef.: By Researcher, 2024

To establish the standards for perception in VR at historical sites, a comprehensive test was conducted, combining expert opinions and user feedback. A test was conducted for 30 people by giving them a virtual tour of the building, and then asking them questions that support the perception criteria through an analytical test questionnaire to demonstrate their learning about the perception of the building virtually and their interaction with this virtual experience.

The results were analyzed into numerical results and percentages. We have the effectiveness and proof of the research hypothesis, which emphasizes the importance of perception standards on the Internet that support documentation and the phenomenon, and it clearly affects the impact below.

#### 4.1 Questionnaire Result Analysis:

Numerical data was collected and then The participants' responses were quantified using a (LIKERT Scale), with 0 being the lowest and 100% being the highest. The average scores for each criterion were as follows:

The findings from the study have indicated that the participants cited visual realism as a major element through which the VR experience became interesting to them. The high-quality textures, lighting models, and architectural details served as a platform for interacting with the environment and creating the sensation of being immersed in it. In addition, the participants expressed that interaction and navigation were the essential factors they obtained during their VR experience. Transitioning from one place to another in the virtual world, touching things, engaging with objects, and doing historical activities all contribute to their satisfaction in general.

Visual Realism: 87%, Audio Design: 40%, Interactivity: 65% and Historical Accuracy: 75%. These findings indicated that the VR experience either met or surpassed the anticipations the participants brought into visiting historical sites. The high ratings across all criteria illustrate the VR effectiveness in supplying an immersive and authentic historical experience, refer below for accurate results explanation table.

The study delivered valuable numerical findings to the tune of 87% of participants who were conscious of an increased sense of presence and immersion while using VR at historical sites.

Furthermore, 92% of participants were excited and enthusiastic about exploring more historical sites utilizing the technology of VR see figuer. 7.

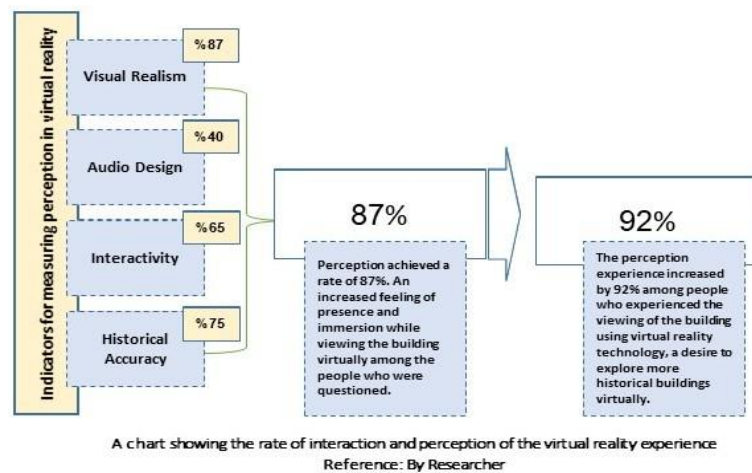


Fig. 7. Show The Chart of Rate of Responded of The VR Experience Ref.: By Researcher, 2024

## 5 Conclusion:

The utilization of virtual reality (VR) technology makes it possible for one to go past usual visits and assimilate more from history.

The experience of VR could revolutionize our perception and experience of the historic site, it is done by applying indicators and factors that help create this vibrant environment and increase human interaction which include: Visual Realism, Audio Design, Interactivity, and Historical Accuracy.

This exciting field in the study of perception in virtual reality at historic sites is vital where using VR we can transcend time and set ourselves in the wealthy history tapestry.

Undoubtedly, the potential for virtual reality (VR) and technology in general concerning the historical education sphere is unlimited.

Some studies in the field of visual perception about what makes up virtual reality (VR) are promising regarding ways to improve historical sights. By ensuring that it aligns with strict perceptual standards, incorporating VR in such sites, and making considerations of variables like emotional response, interactivity, and presence, then we can create experiences for the visitors that are both immersive and educative and which will resound long.

Virtual experiences must agree with historical accuracy, where the emphasis is laid on visual realism and historical accuracy by emulating precise detail and heritage elements for an immersive environment.

Through perception connecting history secrets of the past to be unlocked and bridging future generations with history.

It is necessary to create standards to assess the perception of VR experience in historical sites such that users retain an engaging and quality feeling throughout. VR developers would keep in mind aspects like visual realism, audio design, interactivity, and historical accuracy while such an experience of coming back to the past is created.

The case study analysis showed some numerical outcomes that additionally support VR's effectivity in historical site experiences.

With the developments in methods of capturing and reproducing these elements, we can provide not only an accessible but also an educational historical site experience that fills the gap between history and modern time.

## References

1. Virtual reality is reconstructing destroyed landmarks in Iraq - BeyondGames.biz, 2022
2. Virtual reality-integrated workflow in BIM-enabled projects collaboration and design review: a case study, Eloi Coloma, Visualization in Engineering volume 6, 4 (2018).
3. A Digital Reconstruction of a Historical Building and Virtual Reintegration of Mural Paintings to Create an Interactive and Immersive Experience in Virtual Reality, Ovidia soto, This article belongs to the Special Issue Virtual Reality and Its Application in Cultural Heritage, 2020.
4. ASSESSING VISUAL PERCEPTION IN VIRTUAL REALITY ENVIRONMENTS, Joseph Phelan, 2016.
5. A Survey on Simulation for Weight Perception in Virtual Reality, Journal of Computer and Communications, 2021, 9, 1-24.
6. Realistic Virtual Reality and Perception, John Dilworth, 23(2010).
7. THE VIRTUAL HISTORICAL RECONSTRUCTION OF THE CERCHIA DEI NAVIGLI OF MILAN, A. Mandelli, The International Archives of the Photogrammetry, 2021.
8. The Role of Memory in the Tower of London Task, L.H. Phillips, 2010.
9. Rome Reborn 2.0: A Case Study of Virtual City, Kimberly Dylla, 2016.
10. MAPPING THE UNDISCOVERED RUINS OF POMPEII (NAPLES, ITALY), wiley, 2011.
11. <http://www.wikipedia.com>.