An Integrated Approach to Stimulate Users' Involvement Behavior and Visiting Intention in Wadi Degla Virtual Museum Using PLS-SEM Data Analysis

Yasmeen Abd Elmoaty Attia[1] **Ahmed Erfan Eltobgy[2]**

[1]Faculty of Hotel and Tourism Services Technology,
East Port Said University of Technology, Egypt
[2]Higher Institute of Tourism and Hotels, E.G.O.T.H, Ismailia, Egypt

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Abstract

This research aims to proposes a novel comprehensive conceptual framing model based on the S-O-R (Stimulus-Organism-Response Theory), the Flow Theory, and UTAUT the (Unified Theory of Acceptance and Use of Technology), to explore the impact of VR technological features, specifically those found in the Wadi Degla Protectorate Virtual Museum, on user's involvement behaviour and consequent visit intentions. The reliability of this model is then examined through partial lest squares structural equation modeling (PLS-SEM) using information gathered from a survey of a sample of 420 participants of Wadi Degla Virtual Museum Experience in Cairo between August and December of 2023, with cooperation of Natural Conversation Egypt NCE. The findings indicate that within the realm of VR tourism, elements of flow theory and UTAUT serve as precursors to visitors' behaviours, that is in turn, trigger their involvement with the destination and their intention to visit. Consequently, this research makes noteworthy contributions and offers some insights that can benefit relevant stakeholders seeking to leverage VR technologies in bolstering visitation intent for destinations.

Introduction:

Despite the growing body of literature on virtual reality VR in the tourism field, there remains a gap in the development of inclusive theoretical models aimed at understanding the influence of VR on users' behaviours and intentions to visit destinations (Nguyen et al., 2023). A significant portion of the existing research focusing on the factors shaping user behaviour in VR has relied on single theories such as the Attention, Interest, Desire, and Action model AIDA, the Technology Acceptance Model TAM, the Unified Theory of Acceptance and Use of Technology UTAUT, Flow Theory, or the Stimulus-Organism-Response S-O-R theory (

Disztinger, 2017 ; Myung el al., 2018 ; Vishwakarma 2020 ; Xiaohong and Ivan, 2021 ; Sagnier et al., 2021 ; Ali et al., 2022 ; Anita et al., 2022).

Subsequent study has revealed the inadequacy of relying on individual theories to fully capture user's behaviour when engaging with virtual reality technologies. Lee and Kim (2021) have argued that the traditional TAM may have limitations in elucidating user experiences in VR. Consequently, various studies have sought to integrate the UTAUT and the Theory of Planned Behaviour TPB (Huang, 2023), while others have combined the TAM, Flow Theory, and S-O-R Model (Kim and Hall, 2019; Loureiro, et al., 2020; Nguyen et al., 2023) in order to enhance the understanding of users' behavioural responses to VR technological encounters. In line with this, the current study proposes a novel comprehensive conceptual model based on the S-O-R Theory, the Flow Theory, and UTAUT to explore the impact of VR technological features, specifically those found in the Wadi Degla Virtual Museum, on users' involvement behaviours and consequent visit intentions. This investigation evaluates two key VR features, namely Vividness and Interactivity (Yeh et al., 2017; Wei 2019; Xiaohong and Ivan, 2021; Nguyen et al., 2023), through the S-O-R model. Additionally, it tests variables from the UTAUT Theory and the perceived immersion aspect of Flow Theory (Vishwakarma, 2020; Xiaohong and Ivan, 2021; Nguyen, 2023) as organism components, alongside behavioural engagement and visit intention as response variables within the S-O-R Theory.

Literature Review

Wadi Degla Virtual Museum WDVM

Egypt's Wadi Degla protectorate is currently facing a threat posed by the phenomenon of urbanization. In order to enhance public consciousness regarding this issue, a cohort of individuals, backed by the Non-Governmental Organization NGO known as Nature Conservation Egypt NCE, made the decision to employ 360-Degree Virtual Reality Tour in the protectorate, in order to present The Wadi Degla Virtual Museum WDVM.

The purpose of this initiative is to render the picturesque dunes of this Natural Heritage Site accessible to the entirety of the population, thereby broadening its outreach without any environmental threats (https://preprod.unescogreencitizen.ows.fr).

According to Kim and Hall (2019), the purpose of the 360-Degree Virtual Reality Tour is to either extend or precede guests' prior experiences. With the use of a VR headset, viewers may spin around and explore the video from any aspect thanks to this technology, which was recorded in a genuine location. In order to provide viewers with rich sensory information about the site, genuine audio is added to the visual images in the 360-degree tour (Xiaohong and Ivan, 2022).

The Wadi Degla Virtual Museum WDVM is widely acknowledged as an innovative educational venture that imparts knowledge pertaining to the environment, history, and geology associated with Cairo's Eastern desert entryway in a mobile and dynamic format. By utilizing Virtual Reality VR technology, these undertaking endeavors to bring individuals closer to nature while educating them about one of Egypt's captivating protected regions.

This is accomplished through three 360-degree videos covering the subsequent subjects: Wadi Degla's geological history, The Ecosystems and Biodiversity of Wadi Degla, and The Nature-friendly activities in Wadi Degla. These topics present four primary educational encounters including:

Experience 1: A personalized and exclusive lecture involving a limited number of participants (maximum 16 individuals). This session comprises a 2-hour lecture incorporating

VR videos for all attendees. Subsequent to the lecture, educational materials in print format are distributed to all participants. Experience 2: An open lecture followed by a private VR session. The session commences with an hour-long educational lecture accessible to all individuals interested in gaining insights into the Wadi Degla protectorate. Upon entry, each attendee receives a raffle ticket. At the conclusion of the lecture, 16 raffle tickets are randomly drawn. The fortunate recipients of these tickets are granted the opportunity to view the WDVM videos alongside the team. All participants receive printed educational materials. Experience 3: A public booth. This setup allows anyone with an interest to engage with the VR content and acquire educational materials concerning the protected area. Experience 4: A customized educational session tailored to suit individual preferences and circumstances. In order to guarantee the continuity of this endeavor, fees are typically levied for this service on institutions and communities that are not afflicted by financial hardship. The compensation structure is designed on a sliding scale contingent upon the financial capability of the recipient. A fraction of the charges collected is allocated towards the maintenance of the project's equipment, with the bulk of the proceeds being allocated to sponsor complimentary event at an institution unable to afford the service (www. Unescogreencitizen.com).

The Stimuli Organism Response S-O-R Frame modeling:

The SOR model was originally introduced by Woodworth in 1929 within the realm of cognitive learning. Initially utilized to elucidate the influence of the environment on human behaviour, it subsequently evolved into a fundamental framework for investigating consumer behaviour (Pahrudin et al., 2023). The SOR Theory delineates the psychological elements accountable for individual behaviour occurrences and effectively expounds on the process of impact between stimulus and a person's behavioural intention (Liu et al., 2023).

Within the SOR model, a stimulus S) is defined as an element impacting a person's cognition or emotional processes.

The Organism O represents a person's psychological or cognitive condition shaped by stimulus factors. This concept of Organism O within the SOR theory has been applied to scrutinize various aspects in tourism studies, including perceived enjoyment, perceived usefulness in travel applications (Wu et al., 2021), tourism experiences, environmental awareness (Chen et al., 2023), and social perceptions of destination images (Xu et al., 2022).

The Response R serves as the final component in the SOR Theory, embodying an individual's behavioural response realized through cognitive and emotional mechanisms. Numerous studies have leveraged the Response constructs R within tourism, particularly in contexts such as green purchase intentions, behavioural intentions to visit (Yang et al., 2022), and green consumption (Chen et al., 2023).

Given the aforementioned points, the SOR Theory proves apt for exploring consumer behaviour intentions due to its emphasis on internal emotional and cognitive factors of individuals (Liu et al., 2023). Despite the initial proposal of the SOR theory predating the Internet era and focusing on offline behaviours, it is now extensively employed in investigating online user behaviours. In current research endeavors, scholars opt for the SOR model to delve into the impacts of VR technology on users' visit intentions. This exploration involves employing technology features as stimulus variables, UTAUT and Flow Theory as organism variables, and behavioural involvement coupled with visit intentions as the response variables.

The Unified Theory of Acceptance and Use of Technology UTAUT:

The identification of a suitable model that amalgamates fundamental psychological factors of users concerning virtual technology utilization and travel intention emerges as a crucial concern for both present and future market for researchers in order to accurately anticipate the enduring appeal of Virtual Reality VR (Zhang, 2023).

The Attention, Interest, Desire, and Action AIDA model, which maps out the consumer journey through awareness, interest, desire, and action, is recognized as a prominent theory in advertising and communication (Song et al., 2021). Numerous marketers perceive the AIDA model as beneficial due to its routine application, whether consciously or unconsciously, in the development of marketing communication strategies (Hanlon, 2023). Conversely, criticism has been directed towards this model for its inadequacy in capturing individual behaviours, being predominantly popularized during the initial phases of information technology applications (Zhang, 2023).

The TAM model has faced criticism for neglecting the inherently social aspects of information system innovation and implementation (Venkatesh and Davis, 2000).

A novel framework named as the Unified Theory of Acceptance and Use of Technology UTAUT, was initially devised by Venkatesh to elucidate the acceptance of information systems by users by amalgamating insights from 8 models (TAM Model – The motivational Model – The Theory of Reasoned Action – the Theory of Planned Behavior TPB - The integration of TAM and TPB - Social Cognitive Theory - Innovation Diffusion Theory - model of PC Utilization) (Zhang, 2023).

The original UTAUT model was founded on 4 fundamental constructs: Performance Expectancy PE – Effort Expectancy EE – Social Influence SI – Facilitating conditions FC (Venkatesh et al., 2003). Subsequently, in 2012, the original framework was enhanced by the addition of 3 further constructs to address its limitations: Hedonic Motivation HM – Price Value PV – Habit HB (Venkatesh et al., 2012).

The 7 key constructs of the UTAUT model are utilized in this study and are explicated as follows:

Performance Expectancy: PE denotes the extent to which a user perceives a technology, such as Virtual Reality VR, to be advantageous and beneficial. This concept bears resemblance to the notion of perceived usefulness as employed in the Technology Acceptance Model TAM (Neo et al., 2014). PE plays a crucial role in elucidating consumers' adoption of e-travel and their online travel purchasing behaviour (Ali et al., 2021).

Effort Expectancy: EE pertains to the perceived level of simplicity in using a technology like VR. EE encompasses various aspects including the perceived ease of use, complexity, comprehensibility, and proficiency (Rahman and Sloan, 2017; Gupta and Dogra). Multiple studies argue that the lower the effort required to comprehend a technology, the higher the inclination to accept it (Kang, 2014; Ali et al., 2021).

Social Influence: SI gauges the extent of influence exerted by family, friends, and other significant individuals on a person to utilize information technology applications like VR. Social Influence is akin to the subjective norm discussed within the Theory of Planned Behaviour TPB framework (Venkatesh et al., 2003; Ali et al., 2021).

Facilitating Conditions: FC evaluate the presence of technical and organizational structures that individuals believe are necessary for utilizing a particular technology. Facilitating conditions encompass multiple dimensions such as compatibility, required resources, necessary expertise, specific support, hardware, and supplementary devices (Ibuken et al., 2016; Gupta and Dogra, 2017; Ali et al., 2021).

Hedonic Motivation: HM assesses the enjoyment and amusement derived by an individual from the post-use behaviour of a technology (Venkatesh et al., 2012). Numerous studies have acknowledged that hedonic motivation serves as a fundamental determinant in E-Services (Baptista and Oliveira, 2015). Other research has indicated that hedonic motivation significantly influences the acceptance and usage behaviour of technology (Ali et al., 2021).

Price Value: PV measures the trade-off between the costs and benefits associated with utilizing a specific technology. Researchers have omitted this variable from empirical studies due to the voluntary nature of the Wadi Degla Virtual Museum experiment.

Habit: HB is a measure of how much people directly recognize their tendency to automatically engage in specific behaviours (Bia Gao, 2023). Habit reflects individuals' self-reported past experiences in utilizing a technology. Researchers defined habit as the inclination of a certain individual to perform certain behaviours (Ali et al., 2021). The concept of habit has been explored through various dimensions including routine behaviours, addiction, necessity, and intrinsic inclination (Ibuken et al., 2016; Gupta and Dogra, 2017; Ali et al., 2021).

Flow theory

Flow theory, originally was introduced by psychologist Csikszentmihalyi in 1975, delineates flow as the sensation of fully engaging one's cognitive abilities in a specific task. The theory posits that flow encounters manifest when individuals deeply immerse themselves in particular activities (Nguyen et al., 2023).

The proliferation of information technology has induced the widespread application of Flow Theory in various research endeavors. Notably, Flow Theory has emerged as a prominent theoretical framework for investigating user behaviour in utilizing virtual reality VR technology (Kim and Hall, 2019).

The researchers incorporate the sensation of flow into their VR research paradigm due to the acknowledged significance of the individuals' flow state in virtual tourism. Several dimensions were employed by earlier studies to examine flow experience. Perceived enjoyment and perceived immersion have been found to be crucial aspects of VR users' senses in research on VR tourism.(Nguyen et al., 2023).

In this research, researchers choose only Perceived Immersion PI as main dimension in the Flow Theory, which refers to the degree to which an individual is isolated from reality, because the (UTUAT) involved the dimension of Perceived Enjoyment PE in the constructs of Hedonic Motivation HM.

VR Behavioural Involvement and Visit Intention:

Behavioural involvement pertains to the extent of cognitive engagement and interest evoked by a specific motion or experience (Rahimizhian et al., 2020). This concept of involvement plays a predominant role within tourism context (Nguyen et al., 2023).

Behavioural intention signifies the extent to which an individual has consciously formulated plans to undertake or abstain from certain future behaviours. In the tourism domain, visiting behavioural intention encompasses the intention to visit, the plan to visit, and the readiness to allocate time and financial resources towards tourism services or products (Meng and Choi, 2016a; Meng and Choi, 2016b; Kim et al., 2021). By immersing themselves more in the virtual environments created by VR, individuals may be inclined to invest time, money, and effort in visiting the actual destinations (Rahimizhian et al., 2020; Nguyen et al., 2023).

Rsearch Hypotheses Development:

Drawing upon the Flow Theory and UTAUT, this study extends the Stimulus-Organism-Response SOR model by leveraging VR features to review the influence of Perceived Immersion, Performance Expectancy, Effort Expectancy, Social Influence, Facilitating Conditions, Hedonic Motivation, and Habit on users' Behavioural Involvement and Visit Intention. The research model is depicted in Figure (1).

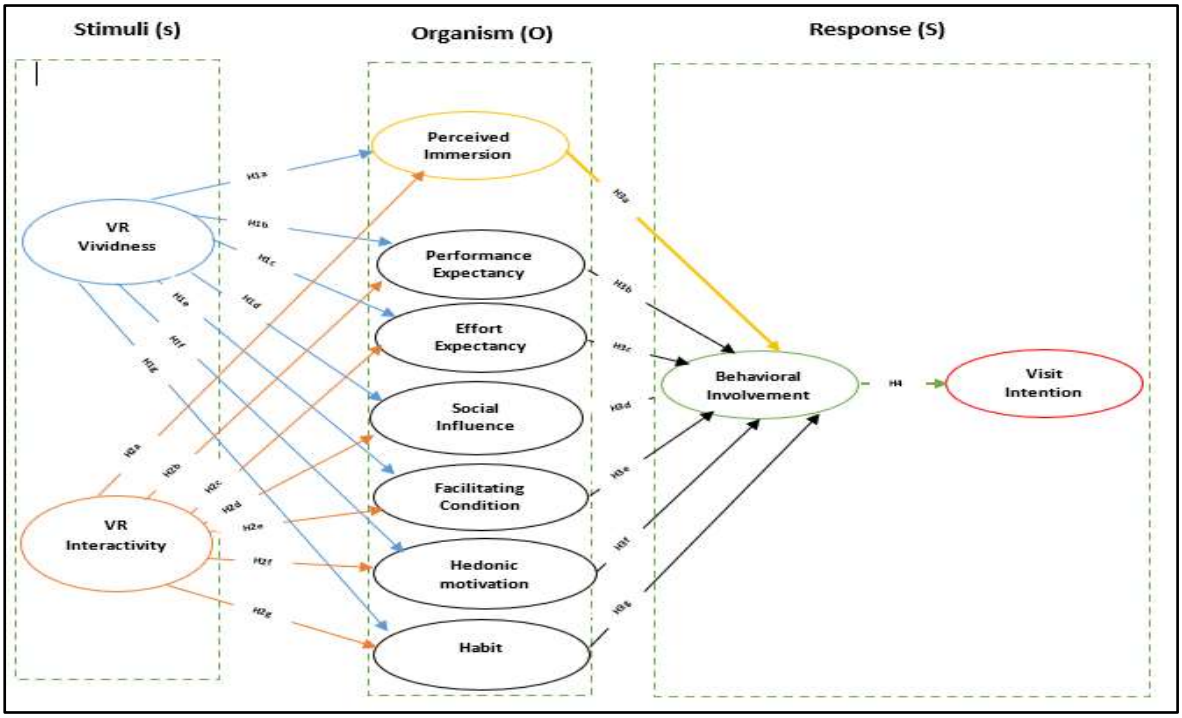

Figure (1). The research conceptual framework.

According to the previous framework, the ensuing hypotheses are:

1- The Relationship Between Stimuli of Virtual Reality VR Technological Features and Users' Organism

Most of the researchers have demonstrated that interactivity and vividness are considered essential dimensions for inducing a sense of telepresence in Virtual Reality VR. These two dimensions are entirely reliant on the technical structure or characteristics of a medium (Kim et al., 2021). The present study utilized interactivity and vividness features as stimuli in VR technology, serving as crucial elements in creating telepresence.

1-1 VR Vividness

Vividness refers to the capacity of a technology to generate a sensory-rich intermediate setting (Nguyen et al., 2023). The vividness aspect of VR technology acts as a stimulus that triggers the users' senses during a VR tour (Vishwakarma et al., 2020; Lee et al., 2021). Previous researches have shown that VR tours with high vividness are linked to increased hedonic and immersion levels among users (Bae et al., 2020). Various researches have brought attention to the positive impact of vividness on Performance Expectancy PE, which involves perceived usefulness. Several research works have demonstrated a positive correlation between vividness and information accessibility. VR has the potential to offer comprehensive information to prospective visitors prior to their actual visit. Consequently, individuals planning a trip may find this information valuable, thereby enhancing the perceived usefulness of VR.

The convenience of using VR may lead to a decrease in Effort Expectancy EE when vividness is high (Celik and Aypar, 2022). Scholars have suggested that users often perceive a sense of "ease of use" while engaging with VR. Through a head-mounted display (HMD), VR users can immerse themselves in a virtual environment and experience a sense of "being there" at the destination (Lee. 2020; Nguyen et al., 2023).

Vividness also influences Social Influence SI by persuading individuals to engage in specific behaviours (Lee, 2020), subsequently affecting attitudes towards VR and behavioural intentions (Kim et al., 2021). Researchers also indicate the direct effect of Vividness on consumer utilitarian and hedonic perceptions in virtual contexts (Aljukhadar et al., 2020; Kang et al., 2020; Kim et al., 2021). These reasoning give rise to the following hypotheses:

The virtual reality's vividness affects positively

H1a: The virtual reality's vividness affects positively the VR users' Perceived Immersion PI.
H1b: The virtual reality's vividness affects positively the VR users' Performance Expectancy PE.
H1c: The virtual reality's vividness affects positively the VR users' Effort Expectancy EE.
H1d: The virtual reality's vividness affects positively the VR users' Social Influence SI.
H1e: The virtual reality's vividness affects positively the VR users' Facilitating Conditions FC.
H1f: The virtual reality's vividness affects positively the VR users' Hedonic Motivation HM.
H1g: The virtual reality's vividness affects positively the VR users' Habit HB.

1-2 VR Interactivity

In the realm of Virtual Reality VR, the term interactivity pertains to modality interactivity, facilitating users' seamless interaction and engagement with the content (Yang and Chen, 2018). Within the field of tourism, developers of VR have utilized interactivity to enhance users' sensory experiences during VR tours. Consequently, VR tours with advanced sensory could provide active features and capabilities that can fully engage individuals' senses in the virtual environment (Kim and Ko, 2019). Previous studies have shown that interactive elements are fundamental in designing features that allow individuals to deeply submerge themselves in the virtual realm (Bae et al., 2020).

Regarding the technical aspect of VR interactivity and its impact on Performance Expectancy PE, earlier researches have indicated a positive correlation between interactivity and users Performance Expectancy encompassing perceived usefulness (Bia Gao, 2023). VR can offer

users more dynamic sensory inputs compared to static videos which creating an environment akin to the actual destination (Celik and Aypar, 2022).

On the other hand, different researches indicated the positive relationship between interactivity and Effort Expectancy EE including ease of use. Users are likely to perceive VR as easy to use if they can easily navigate and manage the interface. Through interactivity, users can access sensory information with minimal exertion (Celik and Aypar, 2022).

Interactivity also have an effect on Social Influence SI by convincing individuals to engage in specific behaviours (Lee, 2020), subsequently affecting attitudes towards VR and behavioural intentions (Kim et al., 2021).

Various studies have highlighted that VR interactivity can enhance users' enjoyment by evoking a sense of hedonic engagement in the virtual space (Bae et al., 2020). The direct influence of interactivity on users' utilitarian and hedonic perceptions in VR has been corroborated by multiple studies. (Aljukhadar et al., 2020; Kang et al., 2020; Kim et al., 2021). These reasoning give rise to the following hypotheses:

H2a: The virtual reality's interactivity affects positively Perceived Immersion PI.
H2b: The virtual reality's interactivity affects positively Performance Expectancy PE.
H2c: The virtual reality's interactivity affects positively Effort Expectancy EE.
H2d: The virtual reality's interactivity affects positively Social Influence SI.
H2e: The virtual reality's interactivity affects positively Facilitating Conditions FC.
H2f: The virtual reality's interactivity affects positively Hedonic Motivation HM.
H2g: The virtual reality's interactivity affects positively Habit HB.

2- VR involvement as the consequential impact to users' Organism Relationship between both representative factors of Flow State Theory and (UTUAT) and Behavioural Involvement (BI):

Perceived Immersion PI within the context of flow theory is widely acknowledged as a valuable tool for elucidating the attitudes, beliefs, behaviours, and intentions of users within virtual environments (Ilhami, 2021; Yao and Jia, 2021; Zheng et al., 2022; Nguyen et al., 2023). It has been established that Perceived Immersion PI exerts a positive influence on the Behavioural Involvement of virtual reality VR users.

As a result, the following hypothesis was created and will be investigated using actual data:

H3a: Perceived Immersion PI affects positively the VR users' Behavioural Involvement (BI).

Numerous studies have shown that users are more inclined towards behavioural engagement when there is a heightened level of Performance Expectancy PE associated with their VR tour experience (Ibukun et al., 2016; Gupta and Dogra, 2017; Rahi et al., 2019; Ali et al., 2021).

Therefore, the subsequent hypothesis was formulated to be scrutinized through empirical evidence:

H3b: Performance Expectancy PE affects positively the VR users' Behavioral Involvement (BI).

Various scholarly works posit that Effort Expectancy EE plays a crucial role as a precursor in both TAM model and UTAUT framing model, thereby impacting behavioural involvement and intention (Venkatesh et al., 2012; Ali et al., 2021). Conversely, certain studies have failed

to discover substantive proof corroborating its influence on behavioral intention (Lu and Su, 2009). Consequently, the present study hypothesizes:

H3c: Effort Expectancy EE affects positively the VR users' Behavioural Involvement (BI).

Several researches found the relationship between Social Influence SI and behavioural involvement (Hariri, 2014; Yueh et al., 2015; Ali et al., 2021). therefore, researchers hypothesize:

H4d: Social influence SI affects positively the VR users' Behavioural Involvement (BI).

According to the UTAUT paradigm, the surrounding environment has the ability to encourage or restrict the acceptance and use of technology. Furthermore, it is anticipated that the availability of favourable conditions for using information technology applications will have a positive impact on behavioural intention (Venkatesh et al., 2012). Additional research minimizes the impact of Facilitating Condition FC on user behaviour prediction (Skoumpopouulou et al., 2018). As a result, researchers arrived at the following hypothesis:

H5e: Facilitating Conditions FC affects positively VR users' Behavioural Involvement (BI).

The literature on information technology has demonstrated that behavioural involvement is directly influenced by hedonic motivation (Venkatesh et al., 2012; Gupta and Dogra, 2017; Ali et al., 2021). This prompted the following hypothesis to be tested:

H6f: Hedonic Motivation HM affects positively the VR users' Behavioural Involvement (BI).

According to certain research findings, habit directly affects behavioural intention (Ali et al., 2021). As a result, the researchers formulate the following hypothesis:

H7g: Habit HB affects positively the VR users' Behavioural Involvement (BI).

3- Relationship between VR Behavioural Involvement BI and Visit Intention VI:

According to earlier research, people who are highly engaged with the virtual destination may become more interested in it, which in succession may elevate their intention to visit (Rahimizhian et al., 2020; Nguyen et al., 2023). Because of this, the way people behave towards a tourist site as a result of their virtual reality VR experience may be a good indicator of their intention to visit. this resulted in the following hypothesis:

H4a: *Behavioural involvement because of the Wadi Degla Virtual Museum has a positive affects the visiting intention.*

Methods

The Study Measurements

This study uses multiple items to measure the effect of VR features on visitors' minds of Wadi Degla Virtual Museum. All items were obtained from related previous literatures. Table (1) shows the measures used in the questionnaire design.

A five-point Likert type scale is accepted, in which the value of 5 refers to "strongly agree" while the value of 1 refers to "strongly disagree."

Table (1) Summery of measures in the conceptual framework

Constructs	Indicators	Reference
STIMULUS		(Nguyen et al., 2023)
(Vividness)		
VVN1	When I am trying the experience of 360-degree virtual tour, the information provided was highly vivid	
VVN2	I found that the 360-degree virtual tour had lots of information.	
VVN3	A richly sensory virtual environment is created by the 360-degree virtual tour.	
(Interactivity)		
INT1	I had complete control over how I navigated the 360-degree virtual tour	
INT2	The interface of the 360-degree virtual tour was interactive.	
INT3	The virtual tour in 360 degrees had my attention and I was engaged.	
ORGANISM		
1- (Flow State)		(Nguyen et al., 2023)
Perceived Immersion		
PIMS1	I had no idea what was going on around me or how to connect to the outside world after I entered virtual reality.	
	I feel totally captivated during my experience.	(Myung et al., 2018)
PMSI2	My experience gave me the impression that I was at the destination.	
PMSI3		
ORGANISM		(Ali et al., 2022)
2- (UTAUM)		(Agostinho et al., 2022)
Performance Expectancy	Experiencing VR Tour is useful for me.	(Huang, 2023)
PE1	Experiencing VR Tour increases my knowledge.	(Bia Gao, 2023)
PE2	I believe that VR can increase users' chance of visiting different destinations.	
PE3		
Effort Expectancy		
EE1	Experiencing the usage of VR is simple and understandable.	
EE2	Using interface of VR is not complicated.	
EE3	Skillfully using VR Tour is easy.	
Social influence		
SI1	People that have an impact on my behavior believe that virtual reality has a place in tourism.	
SI2	People highly important to me feel that VR experience is useful.	
SI3	People whose opinion important to me feel that VR experience is utilitarian.	
Facilitating Conditions		
FC1	I received the information I needed to use the virtual reality device.	
FC2	if i have difficulties in using VR software, I can get assistance from others.	
FC3	VR experience surrounding environment was suitable	

Constructs	Indicators	Reference
Hedonic Motivation		
HM1	Experiencing the destination by using VR technology was enjoyable.	
HM2	Experiencing the destination by using VR technology was exciting.	
HM3	Experiencing the destination by using VR technology increases my experience.	
Habit		
HB1	Using VR tourism become natural to me.	
HB2	The advantages of VR tours have made me addicted to their use.	
HB3	It becomes a must-do for me to experience VR.	
RESPONSE		(Nguyen et al., 2023)
Behavioural Involvement		(Myung et al., 2018)
BI1	After viewing the VR Tour, I gained an interest in the destination's attractions.	
BI2	After seeing the VR Tour, I would like to discuss my wish to visit the location with others.	
	I plan to keep using VR Tour.	
BI3	I became attentived to the different ingrediants of the destination after watching the VR Tour.	
BI4	After viewing the VR tour, I would like to speak with visitors who have been there.	
BI5		
Visit Intention		
VS1	I may go to the destination in the future.	
VS2	I'm willing to make a visit to the destination in the future.	
VS3	In the future, I plan to spend both money and time travelling to the destination.	

Sampling and Data Collection

A purposive non-probability sample chosen in accordance with the study's goals and the population's characteristics is used for the investigation. Questionnaires were distributed to Wadi Degla Virtual Museum experiment participants in Cairo between August 2023 and December of 2023, with cooperation of Natural Conversation Egypt NCE, which is considered an Egyptian non-governmental organization that works to preserve Egypt's natural heritage and promote its sustainable usage. Furthermore, it is the responsible party of organizing virtual tours for Wadi Degla Natural Protectorate (https://www.natureegypt.org/).

Before carrying out the initial survey questionnaire, a pre-test was carried out to validate its content, inclusiveness, and clarity. The pre-test engaged a board of specialists consisting of ten VR users and three experts in the field of technology adoption. The pre-test proposed slight enhancements in language and terminology to enhance the user-friendliness of the survey questionnaire for VR users.

Subsequent to revisions, the survey questionnaire underwent a pilot test with a cohort of thirty VR respondents to affirm the consistency of the measurement scale. In response to the feedback received, certain minor modifications were implemented.

The questionnaire was given to a sample of 420 respondents. Issues such as missing numbers, outliers, and normality were among the problems that were addressed through a cleaning and review process of the data. Consequently, twenty-two submissions that contained outliers,

missing data, or unanswered questions were eliminated. Statistical analysis was performed on a final dataset that included 398 valid replies.

Descriptive Results:

Table (2) displayed the Characteristics of survey's respondents.

Table (2) Respondents' characteristics

Characteristics	Frequency	%
Gender		
Male	165	42
Female	233	58
Age		
16< 22 years	184	46.23
23 < 30 years	111	27.8
>30 years	103	25.8
Education		
High school	154	38.69
Diploma	67	16.83
Bachelor	260	65.32

The descriptive results clarified that 42% of the targeted respondents were male, and 58% were female. Concerning the age level, 46% of the participants were aged between 16 and 22, 27.8% were aged between 23 and 30, and finally 25.8% were 30 years or older. The educational level revealed by the participants stated that 38.69 had a secondary high school, 65.32 % had obtained undergraduate degree, and only 16.83 had a post graduate level.

Data Analysis Techniques

"Partial Least Squares" PLS and "Structured Equation Modeling" SEM were conducted by using Warp PLS 7.0 so that, the proposed theoretical hypotheses could be examined.

In the literature on empirical tourism management, PLS-SEM is a commonly applied tool in analyzing data (Al-Azab and Al-Romeedy, 2023). It is considered a proper approach for reviewing complex structural models with direct and indirect paths between multiple-item variables (Manley et al, 2021).

The current research methodology employed for data analysis, is consisted of a three-stage process, specifically, the evaluation of reliability and validity, examination of the measurement framework, and analysis of the structural framework.

Data Analysis Results

Initially, the measurement constructs underwent exploratory factor analysis to assess their significance, evaluation, and interpretation. Factor extraction was based on a minimum eigenvalue of 1, while a construct loading of 0.5 was employed for enhanced accuracy as proposed by Hair et al. (2010). All constructs' loadings in the recent investigation, which ranged from 0.552 to 0.874, were computed and viewed to be acceptable.

Eeach element within the theoretical framework was assessed using multiple indicators, it was imperative to examine the internal consistency. The reliability of the eleven factors that were kept was determined by applying Cronbach's Alpha (α) coefficient to the assessment of internal consistency, as table 3 illustrates. The coefficient values ranged from 0.681 for VR

Vividness to 0.803 for Perceived Immersion, demonstrating satisfactory results in the evaluation of each element's reliability.

Subsequently, the previously indicated components—which included each indicator's factor loading, composite reliability (CR), and average variance extracted (AVE)—were examined for convergent validity. An AVE of 0.5 or higher was seen as adequate, and a construct reliability criterion of 0.7 was found to be satisfactory (Shrestha, 2021).

As illustrated in Table (3), the composite reliability for all variables is deemed adequate, with values exceeding 0.7, falling within the range of 0.707 to 0. 882. Furthermore, in accordance with Hair et al., (2010) predefined criteria, the convergent validity of the scales is established as the AVE values surpass 0.5, falling within the range of 0.571 to 0. 842.

Discriminant validity was also evaluated for each construct in the study. In order to ensure adequate discriminant validity, it was necessary for the square roots of the Average Variance Extracted (AVE) for each factor to surpass the correlation coefficient among that particular factor and other factors as emphasized by Franke and Sarstedt (2019).

Table (3) Factorial validity, reliability, and convergent validity

factors	Item	Loading	α	CR	AVE
VR Vividness	**VIV1**	**0.840**	**0.800**	**0.882**	**0.845**
	VIV2	**0.841**			
	VIV3	**0.854**			
VR Interactivity	**INT1**	**0.827**	**0.794**	**0.879**	**0.842**
	INT2	**0.870**			
	INT3	**0.827**			
Perceived Immersion	**PIMS1**	**0.799**	**0.803**	**0.882**	**0.848**
	PIMS2	**0.869**			
	PIMS3	**0.873**			
Performance Expectancy	**PE1**	**0.874**	**0.777**	**0.871**	**0.832**
	PE2	**0.841**			
	PE3	**0.777**			
Effort Expectancy	**EE1**	**0.798**	**0.702**	**0.834**	**0.792**
	EE2	**0.810**			
	EE3	**0.766**			
Social Influence	SI1	0.798	0.675	0.822	0.779
	SI2	0.810			
	SI3	0.766			
Facilitating Condition	FC1	0.760	0.707	0.837	0.794
	FC2	0.832			
	FC3	0.789			
Hedonic Motivation	HM1	0.838	0.789	0.877	0.839
	HM2	0.859			
	HM3	0.819			
Habit	HB1	0.834	0.756	0.860	0.820
	HB2	0.781			
	HB3	0.844			
Behavioural Involvement	BI1	0.710	0.642	0.777	0.648
	BI2	0.734			
	BI3	0.659			
	BI4	0.600			
	BI5	0.679			
Visit Intention	VS1	0.783	0.681	0.707	0.571

factors	Item	Loading	α	CR	AVE
	VS2	0.659			
	VS3	0.552			

Table (4) presents the correlation coefficients between the variables, and the diagonal shows the square root of the AVE. The square roots of the diagonal AVE values were greater than the correlation coefficients between a particular variable and other variables, according to the analysis of the data, which showed that all correlation coefficients stayed below 0.9.

These findings clearly indicated the successful attainment of acceptable discriminant validity among the constructs Hair et al., (2010).

Table (4) Correlations among Variables

	PE	HM	PIMS	VIV	EE	SI	HB	INT	FC	BI	VS
PE	0.832										
HM	0.749	0.839									
PIMS	0.703	0.810	0.848								
VIV	0.676	0.719	0.625	0.845							
EE	0.626	0.687	0.701	0.735	0.792						
SI	0.568	0.664	0.653	0.665	0.698	0.779					
HB	0.698	0.686	0.721	0.559	0.601	0.577	0.820				
INT	0.501	0.490	0.421	0.539	0.508	0.519	0.455	0.842			
FC	0.549	0.476	0.427	0.531	0.510	0.526	0.514	0.623	0.794		
BI	0.727	0.781	0.771	0.635	0.662	0.734	0.640	0.516	0.525	0.648	
VS	0.606	0.690	0.605	0.746	0.696	0.648	0.552	0.416	0.422	0.606	0.671

The second phase in the analysis method was to perform a confirmatory factor analysis. Research model quality and model fit indexes. Model fit was examined using a variety of model fit indices to assess how well the model fit the data prior to testing the hypotheses. Kock (2021) states that every model fit and quality index result satisfies the conditions listed in table (5).

Table (5) Model fit and quality indices

	Evaluation	Standard	Decision
APC	0.318, P< 0.001	P < 0.05	supported
ARS	0.499, P< 0.001	P < 0.05	supported
AARS	0.494, P< 0.001	P < 0.05	supported
AVIF	1.876	Acceptable if < = 5	supported
AFVIF	3.180	Acceptable if < = 5	supported
GoF	0.561	Small > = 0.1, medium > = 0.25, large > = 0.36	supported
SPR	1.000	Acceptable if > 0.7, ideally =1	supported
RSCR	1.000	Acceptable if > 0.9, ideally =1	supported
SSR	1.000	Acceptable if > 0.7	supported
NLBCDR	1.000	Acceptable if > 0.7	supported

The study hypotheses were tested in the third step using SEM. hypotheses investigated by calculating the direct impacts between latent variables. The results of testing the hypotheses showed that 18 of the 22 hypotheses, which included H1c, H1d, H1e, H1g, H2a, H2c, H2d, H2e, H2f, H2g, H3a, H3b, H3c, H3d, H3e, H3f, H3g, and H4, were statistically significant with a P value of less than 0.01. Nevertheless, the least supported hypotheses, H1a, H1b, H1f, and H2b, do not have a P>0.01 value.

Table (6) Hypotheses testing

Hypotheses	Path Coefficients	Sig	Decision
H1a. Vividness – Perceived Immersion	0.130	P= 0.03	Not Supported
H1b. Vividness – Performance Expectancy	0.07	P= 0.45	Not Supported
H1c. Vividness – Effort Expectancy	0.642	P< 0.01	Supported
H1d. Vividness – Social influence	0.531	P< 0.01	Supported
H1e. Vividness – Facilitating Condition	0.279	P< 0.01	Supported
H1f. Vividness – Hedonic Motivation	0.05	P= 0.23	Not Supported
H1g. Vividness – Habit	0.442	P< 0.01	Supported
H2a. Interactivity - Perceived Immersion	0.557	P< 0.01	Supported
H2b. Interactivity - Performance Expectancy	0.03	P= 0.32	Not Supported
H2c. Interactivity - Effort Expectancy	0.172	P< 0.01	Supported
H2d. Interactivity - Social influence	0.251	P< 0.01	Supported
H2e. Interactivity - Facilitating Condition	0.474	P< 0.01	Supported
H2f. Interactivity - Hedonic Motivation	0.155	P< 0.01	Supported
H2g. Interactivity – Habit	0.249	P< 0.01	Supported
H3a. Perceived Immersion – Behavioural Involvement	0.267	P< 0.01	Supported
H3b. Performance Expectancy - Behavioural Involvement	0.231	P< 0.01	Supported
H3c. Effort Expectancy - Behavioural Involvement	0.571	P< 0.01	Supported
H3d. Social influence - Behavioural Involvement	0.293	P< 0.01	Supported
H3e. Facilitating Condition - Behavioural Involvement	0.637	P< 0.01	Supported
H3f. Hedonic Motivation - Behavioural Involvement	0.200	P< 0.01	Supported
H3g. Habit - Behavioural Involvement	0.211	P< 0.01	Supported
H4. Behavioural Involvement – Visit Intention	0.620	P< 0.01	Supported

Discussion

This research presents an integrated theoretical framework designed to explore the effect of VR technological features on users' behaviours and intentions to visit. The outcomes offer partial backing for the hypotheses put forth in the study concerning users' reactions while engaging with VR technologies. Broadly, the findings indicate that virtual reality's features can serve as stimuli influencing individuals' behaviours and attitudes, thereby underscoring the value of the conceptual model proposed in this study.

Notably, out of the twenty-two research hypotheses, eighteen garnered supports. the results suggest that within the realm of VR tourism, elements of flow theory and UTAUT serve as precursors to tourists' behaviours, corroborating Hypotheses H3a, H3b, H3c, H3d, H3e, H3f, and H3g respectively. These results are consistent with the prior studies (e.g. Venkatesh et al., 2012; Ibukun et al., 2016; Gupta and Dogra, 2017; Skoumpopouulou et al., 2018; Rahi et al., 2019 ; Ali et al., 2021). Tourists' behaviours, in turn, trigger their engagement with the destination and their intention to visit, thereby upholding hypothesis H4. Existing literatures also assert that (e.g. Rahimizhian et al., 2020; Nguyen et al., 2023).

These results propose that VR technology may emerge as a valuable promotional tool for tourist destinations, particularly for lesser-known sites such as natural protectorates like Wadi Degla Protectorate. Moreover, based on users' perceptions of technology acceptance, VR features -including vividness and interactivity- can impact Effort Expectancy, Performance Expectancy, , Facilitating Conditions, Social Influence , Hedonic Motivation, and habit.

Nevertheless, the degree to which each VR feature influences users' perceptions varied within this study.

VR vividness positively affects Effort Expectancy, Social Influence, Facilitating Conditions, Hedonic Motivation, and habit among users, while the interactivity of VR positively impacts perceived immersion and all UTAUT factors except Performance Expectancy. Consequently, interactivity emerges as the most influential determinant of users' emotional flow in VR. The findings thus underscore the significance of VR features in shaping users' perceptions of VR adoption. These current findings support earlier studies (e.g. Kim and Ko, 2019; Bae et al,. 2020; Lee, 2020; Kim et al., 2021; Celik and Aypar, 2022; Nguyen at al., 2023).

The findings, however, suggest that vividness has little effect on hedonic motivation, performance expectations, or perceived immersion. A non-immersive VR experience may fail to meet individuals' expectations for total immersion in the virtual world, which could explain why there is a negative correlation between VR vividness and perceived immersion as well as between VR vividness and hedonic motivation.

Furthermore, both VR interactivity and vividness do not significantly affect Performance Expectancy, highlighting the constraints of VR technology for tourists. Due to the proliferation of digital technologies within the tourism sector, Virtual reality (VR) holds promise as a powerful promotional tool for travel destinations. Travelers may view VR as a viable platform for influencing their selection of travel destinations. Thisoutcome is accordant with other researches (e.g. Myung et al., 2018 and Ali et al., 2021).

To optimize the efficacy of VR, marketing professionals in the tourism industry must prioritize the enhancement of VR features, including richness and interactive capabilities. The current investigation highlights the favorable impact of interactivity on Perceived Immersion, Social influence, Effort Expectancy, Facilitating Condition, Hedonic Motivation, and habit, underscoring the importance of seamlessly integrating interactivity into VR to enrich individuals' experiences and their intent to visit.

Moreover, the study's findings reveal insignificance in the relationships among VR vividness and perceived immersion, Performance Expectancy, and Hedonic Motivation, presenting implications for the development of VR initiatives for destinations. Consequently, this research makes noteworthy contributions and offers valuable insights that can benefit relevant stakeholders seeking to leverage VR technologies in bolstering visitation intent for destinations.

Conclusion and Implications

This research aims to proposes a novel comprehensive conceptual framework based on S-O-R Theory, UTAUT, and the Flow Theory, to determine the VR technological features, specifically those found in the Wadi Degla Protectorate Virtual Museum, which prompt user's involvement behaviour and consequent visit intentions.

Partial least squares structural equation modelling (PLS-SEM) is used to investigate the validity of this framework using data from a survey of Wadi Degla Virtual Museum Experience participants in several locations in Cairo, with the cooperation of Natural Conversation Egypt NCE.

The findings suggest that within the realm of VR tourism, elements of flow theory UTAUT serve as precursors to users' behaviours, that is in turn, trigger their involvement with the destination and their intention to visit. Consequently, this research makes noteworthy contributions and offers valuable insights that can benefit relevant stakeholders seeking to leverage VR technologies in bolstering visitation intent for destinations.

The findings of this study offer practical implications for entities involved in tourism development and marketing. A significant relationship has been seen between VR behavioural engagement and visit intention. Consequently, the emphasis in a marketing approach should be placed on VR tours rather than cutting-edge technology, as a fundamental element in alluring visitors. Thus, it is advisable for tourism developers to recognize VR as a potent marketing instrument that can enhance the intention to visit the destination, thereby fostering sustainable economic growth. Additionally, developers in the tourism sector should strive to design VR tours that prompt visitors to participate more actively.

By providing high-quality VR experiences, tourists may be encouraged to dedicate more time and effort to seeking information, consequently improving their overall attitude towards the physical visit.

furthermore, the results of this investigation indicate insignificant correlations between VR vividness and perceived immersion, Performance Expectancy, and Hedonic Motivation. Additionally, there is a lack of significant association between VR interactivity and Performance Expectancy. These results suggest deficiencies in VR tours concerning their ability to stimulate the sensory experiences of VR users. Consequently, NCE and other relevant bodies should prioritize enhancing VR attributes like vividness and interactivity to enhance the appeal of VR for visitors, and subsequently, their satisfaction. To achieve this goal, NCE should involve key stakeholders in the development of VR programs, incorporating unique destination features to increase the utility of VR for prospective tourists.

Virtual Reality applications also, has an important role must be considered from tourism stakeholders for achieving tourism sustainability. From an economic standpoint, it is imperative for tourism stakeholders to focus on optimizing VR initiatives that have the potential to streamline the information-seeking process for users. Users tend to engage with VR destinations and opt to physically visit the actual destination if their VR experience proves satisfactory. This, in turn, contributes to a boost in the economic prosperity of the destination.

Moreover, the design of VR should facilitate virtual exploration of locations that impose restrictions on direct visitation in order to safeguard the environment, such as natural reserves and historical sites. This approach can foster a sense of environmental stewardship among visitors towards tourism assets. These arguments underscore the pivotal role of VR in augmenting tourism promotional strategies and fostering the sustainable advancement of tourist destinations.

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مدخل متكامل لتحفيز سلوكيات الارتباط للمستخدمين ونوايا الزيارة في متحف وادي دجلة الافتراضي باستخدام أسلوب نمذجة المعادلات البنائية باستخدام المربعات الصغرى الجزئية

ياسمين عبد المعطي عطية[١] **أحمد عرفان الطوبجي**[٢]

[١]كلية تكنولوجيا الخدمات الفندقية والسياحة- جامعة شرق بورسعيد التكنولوجية- جمهورية مصر العربية

[٢]المعهد العالي للسياحة والفنادق- إيجوث- الاسماعيلية- جمهورية مصر العربية

ملخص البحث:

يهدف هذا البحث إلى تقديم إطار مفاهيمي شـــامل من خلال نظرية المثير والاســـتجابة، النظرية الموحدة لقبول التكنولوجيا، ونظرية التدفق النفسية، لتوضـيح أثر سمات الواقع الافتراضـي التكنولوجية المطبقة في متحف وادي دجلة الافتراضـــي على سـلوكيات ارتباط المسـتخدم بالمقصـد ونواياه للزيارة. اعتمدت الدراسـة على المنهج الكمي لدراسـة العلاقة بين المتغيرات، واسـتعانت بالمسـح الميداني من خلال من خلال توزيع قوائم اسـتقصـاء على عينة بلغ حجمها ٤٢٠ مفردة من ستخدمي تجربة متحف وادي دجلة الافتراضي في مدينة القاهرة، في الفترة بين شهري أغسـطس و ديسـمبر ٢٠٢٣، بالتعاون مع الجمعية المصـرية لحماية الطبيعة والتي تعتبر جمعية أهلية مصـرية تعمل على الخفاظ على تراث مصر الطبيعي والترويج لاستغلاله بطريقة مستدامة، وهي شريك أساسي في تجربة متحف وادي دجلة الافتراضي. تم التحقق من صلاحية الإطار واختبار فرضيات الدراسة باستخدام أسلوب نمذجة المعادلات البنائية باستخدام المربعات الصغرى الجزئية.. أظهرت نتائج الدراسة أن عناصر نظرية التدفق والنظرية الموحدة لقبول التكنولوجيا تعتبر مؤشـر لسـلوكيات المسـتخدمين، التي تحفز بدورها سـلوكيات ارتباط المسـتخدم بالمقصـــد وبالتالي نواياه للزيارة. يقدم هذا البحث مســـاهمات جديرة بالملاحظة ورؤى يمكن أن تفيد أصـــحاب المصلحة المعنيين الذين يسعون إلى الاستفادة من تقنيات الواقع الافتراضي في تعزيز نية الزيارة للوجهات.

الكلمات الدالة:الواقع الافتراضي – متحف وادي دجلة الافتراضي – نظرية المثير والاستجابة – النظرية الموحدة لقبول التكنولوجيا – نظرية التدفق