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VALIDATION OF HYBRID MODEL FOR IMAGE-BASED VIRTUAL REALITY IN SELF-THERAPY THROUGH EXPERT REVIEW METHOD

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ABSTRACT

Virtual reality (VR) is a tool that can induce a sense of presence in the user. It has been proven effective in reducing psychological stress. Traditionally, one of the psychotherapy techniques for managing stress is Guided Imagery Therapy (GIT). There are situations where clients have difficulties imagining the scenarios during the GIT session. VR can be an alternative solution that presents virtual calm scenarios to relieve stress, instead of using imagination. Hence, this study aims to propose a model for Image-based VR (IBVR) that hybridises the Spatial Presence Model (SPM) and GIT for self-therapy. The proposed hybrid model was developed through a model design and validated through the expert review. The results of the expert review indicated the need for improvement in terms of detailing the elements and descriptions, as well as the representation of relationships of the components. The revised hybrid model exhibits more relevancies of the elements and components, as well as the readability and understandability of the proposed model. The hybrid model is expected to assist application designers and developers in creating an IBVR tool for self-therapy.

Keywords: Image based virtual reality, spatial presence, guided imagery therapy, stress management, expert review method.

INTRODUCTION

Virtual reality (VR) is a technology or tool in multimedia created to induce user experience with the sense of presence and immersion during their interaction with the VR tool (Chilana et al., 2015; Jo et al., 2019; Lin et al., 2019). The sense of presence in VR refers to the user's feeling of "being there" in a computer-generated virtual world environment (Shelstad et al., 2017). The sense of presence generates UX characteristics in VR applications (Diyana & Rambli, 2012; Lorenz et al., 2018) that can increase user satisfaction and offer unique experiences (Muhaiyuddin & Rambli, 2014), providing users with a novel way to engage with digital content (Martín-Gutiérrez et al., 2017). The ability of VR to evoke presence underscores its potential for creating impactful experiences (Kim & Hyun, 2022). Among others, VR has been investigated for its effects on reducing psychological stress and other applications (Chirico et al., 2018; Yang et al., 2021).

Stress is a psychological disorder that originates from the perception or expectation of the environment (Pinto et al., 2019). People who experience stress tend to have negative emotional responses that include depression, tension, anxiety and other biological reactions that can affect their health. It can also decrease work performance and further impact the productivity of an organisation (Lebel, 2013; Mawanza, 2017). While academic-related stress can affect students' achievement and motivation and increase the risk of dropping out of school (Subha & Shakil, 2009). Therefore, it is necessary to manage stress appropriately to avoid the occurrence of other psychological and behavioural disorders. One of the traditional psychotherapy approaches to managing stress is by using imagery or imaginary therapy techniques (Pascoe et al., 2019; Latif et al., 2015), which is also known as Guided Imagery Therapy (GIT). In this type of therapy, a therapist instructs and guides the client to imagine a relaxing scene or experience (Robinson et al., 2019). However, there are instances where clients find it difficult to imagine the scenarios as a result of their mentally influencing life experiences. At times, clients may misunderstand the therapist's guidance and create negative scenarios in their minds (Owen, 2016). VR can be an alternative solution that provides a storyline (Nadia & Dayang, 2018). It can present virtual calm scenes in a mediated environment to induce relaxation instead of relying on the client's imagination and memory.

Fundamentally, VR can be classified into two main types: geometry-based VR (GBVR) and image-based VR (IBVR). Technically, GBVR is a computer-generated virtual environments (VE) created using three-dimensional (3D) graphics software. It can produce a high level of presence as it provides high interactivity (Rambli & Muhaiyuddin, 2014; Cassati & Pasquinelli, 2005)). However, for GBVR, creating a realistic VE is time-consuming and high in computational cost (Rambli & Muhaiyuddin, 2014). For that reason, IBVR is considered an alternative to GBVR because it takes less time to develop. Although no geometric programming is involved in its development, IBVR can produce a realistic virtual environment (Chen, 1995) using low computer processing performance. Although 360° video can be considered to fall under the same category as IBVR due to their photorealism characteristic, it is not considered to be included in this study. It is because of its limitations in terms of linear and passive experiences, restricting users to a fixed viewpoint within a predetermined narrative. Furthermore, the fixed perspective can induce cybersickness if the camera motion does not align with the user's vestibular expectations (Slater & Sanchez-Vives, 2016).

Hence, this study proposes an approach for self-therapy by using IBVR. With this approach, users with mild and moderate stress levels can undergo the therapy on their own through the IBVR, without direct intervention from an actual therapist. Nevertheless, it is crucial to ensure that users can feel a sense of presence in the IBVR environment despite the limitation of its interaction functions compared to GBVR. Accordingly, this study attempts to bridge the gap by hybridising the Spatial Presence model (SPM) and GIT technique to apply IBVR in self-therapy. The proposed hybrid model is expected to benefit the application designers and developers as a reference in developing the IBVR tools. The following section gives an overview of the research background, followed by description of the methodology for designing and validating the proposed hybrid model.

BACKGROUND

Virtual Reality and Presence

Virtual reality (VR) can be defined as a computer-generated digital environment that simulates the characteristics of a real-world setting, enabling users to both experience and interact with it (Jerald, 2016). The rapid advancements in virtual reality (VR) have facilitated its widespread application across diverse domains, encompassing healthcare, education, industrial design, manufacturing, and engineering, social and psychological support, entertainment and cultural sectors (Hartmann & Fox, 2019; Mazhar & Rifaee, 2023; Tene et al., 2024; Pulver, 2025). Particularly, in mental health, VR has been utilized as a therapy tool in managing stress and proven to be able to decrease stress level and increase task performance (Pallavicini, Argenton, & Mantovani, 2016; Eswaran, Veezhinathan, Balasubramanian, & Taneja, 2018; Perez-Valero et al., 2021; Téllez et al., 2023).

In virtual reality (VR), it is important that users experience a strong sense of presence, defined as the psychological perception of being physically present in a mediated environment, as well as a sense of agency, characterized by the perceived ability to act and interact within that environment. (Wirth et al., 2007; Skarbez et al., 2020; Slater & Sanchez-Vives, 2016). Research on presence in VR has predominantly centred on GBVR due to its capacity for fostering deep immersion via sophisticated interaction capabilities (Casati & Pasquinelli, 2005; Luciani, Urma, Marlière, & Chevrier, 2004). However, a major challenge for this approach is the development of a realistic synthetic environments which demands considerable time and high computing performance as it relies on complex 3D computer graphics (Casati & Pasquinelli, 2005; Geng, Pan, Li, & Yang, 2000; Keil et al., 2021; Kaur et al., 2022). In contrast, IBVR constructs realistic environments by stitching together real-world photographs. Compare to GBVR, this approach is less time-consuming and requires lower computing performance (Bradley et al., 2005; Dayang et al., 2011; Nadia & Dayang, 2018). Studies have demonstrated that IBVR can also be an effective tool for many fields like psychotherapy (Dayang et al., 2011; Nadia & Dayang, 2018). However, to maximize its effectiveness, it is crucial to induce a sense of presence within these environments, even with the limitations of its interaction functions, when compare to GBVR.

Spatial Presence Theories

The conceptualization of presence has been addressed from multiple theoretical perspectives. Lombard and Ditton (1997) introduced a theoretical framework addressing presence and social presence, but not specifically engage with the notion of spatial presence. Building on this, Nicovich (2005) proposed a spatial presence theory designed for highly interactive applications, a framework that is less applicable for lower levels of interactivity as in IBVR. Similarly, Riva et al. (2011) emphasized application-related factors that influence sense of presence, yet the model do not provide a detailed description of the directions or interrelationships among the variables. Other earlier conceptualizations of spatial presence theory by Draper (1998), Steuer (1992), Slater et al. (1996), and Schubert et al. (1999) mostly focus on the psychological perspective of human cognition and perception, which deviates from this study's emphasis on media-related factors contributing to the induction of spatial presence rather than human-centred determinants.

In contrast, Wirth et al. (2007) proposed a theoretical model of spatial presence that integrates both media and human factors that is applicable across diverse media forms. Mohd Muhaiyuddin (2017) refined Wirth et al.'s model by developing a spatial presence model tailored for IBVR (SPM4IBVR). Unlike Wirth's approach, Mohd Muhaiyuddin's model focus on the media factors as the primary determinants of spatial presence, excluding human factors. It provides a general conceptualization of spatial presence within IBVR contexts, but insufficiently specialized for applications in self-therapy. On the other hand, Huang et al. (2019) studied the influence of presence on educational VR/AR technology but focused primarily on psychological and cognitive responses. While, Makransky and Petersen (2021) introduced a model that include presence and agency as the general psychological affordances of VR for learning. Likewise, Luo and Sun (2025) designed a framework for a sustainable e-learning in virtual learning environments by integrating social presence and spatial presence. However these studies are predominantly focus on improving perceived enjoyment, learning engagement, knowledge acquisition and transfer in educational context. Based on these justification, the current study considers SPM4IBVR by Mohd Muhaiyuddin (2017) as the foundation of the proposed model. Despite this work being a general IBVR model that is not specifically tailored for therapeutic purposes, the components and elements included in the model can be further explored to suit the objectives of this study.

Guide Imagery Therapy

Guided imagery or GIT is the technique where elements of the unconscious mind are provoked to appear in the conscious mind through variety of techniques including simple visualization and imagery, metaphor and story-telling, fantasy exploration and game playing, dream interpretation, drawing, and active imagination. It is proven to be an effective intervention for reducing stress and anxiety (Jallo, Ruiz, Jr, & French, 2014; Prabu & Subhash, 2015). Normally, the process involve a therapist guiding the patient to imagine 'being in' a relaxing scene, preferably a favourite location (Nadia & Dayang, 2018), thus giving the sensation of relaxation. However, there are possibilities that the patient misunderstand the therapist instructions and consequently imagine scenarios that could affect them negatively. This study proposes a technology-based solution using IBVR as a self-therapy tool, based on GIT technique. Users can view the scenario in IBVR instead on using imagination. Prabu and Subhash (2015) also denoted that imagery therapy can also be applied as a self-therapy approach using self-help imagery books and tapes.

METHODOLOGY

The activities of developing the hybridised model of spatial presence and GIT for IBVR in self-therapy include model design and validation before creating a prototype for user evaluation. Figure 1 illustrates these activities. The figure shows that the proposed hybrid model is designed and built based on the components and elements produced from content analysis and comparative analysis of existing studies. Fundamentally, development of the hybrid model was based on the model introduced by Mohd Muhaiyuddin (2017) which has created a spatial presence model for IBVR (SPM4IBVR). This model has proposed three main components to generate spatial presence in IBVR which are interactivity, perceptual realism and calmness. Each of these components contains specific elements and principles that contribute to the creation of a sense of spatial presence in IBVR, as illustrated in Figure 2.

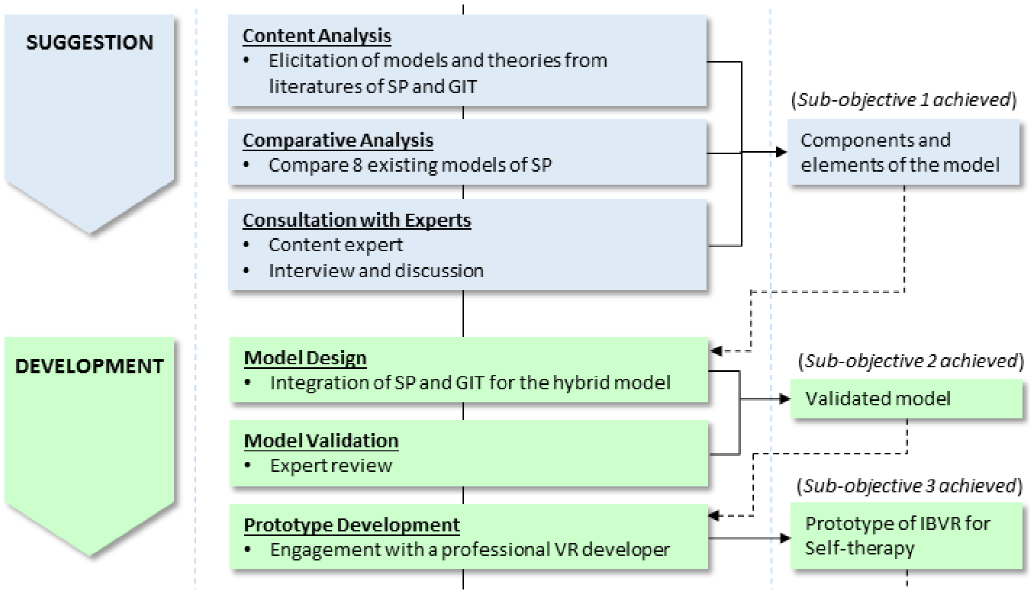

Figure 1. Model development methodology

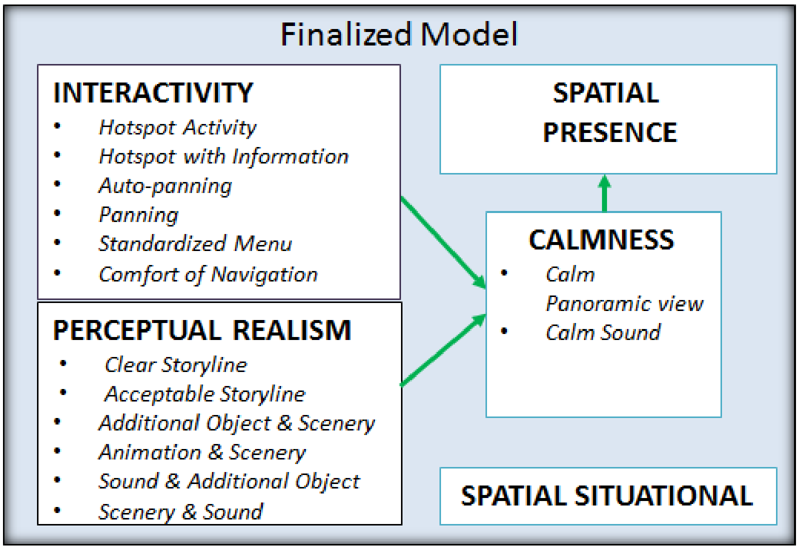

Figure 2. Spatial Presence Model for IBVR (SPM4IBVR) (Mohd Muhaiyuddin, 2017)

Based on Figure 2, the SPM4IBVR posits three essential components for enhancing spatial presence in IBVR: (1) interactivity, (2) perceptual realism, and (3) calmness. Within this framework, interactivity and perceptual realism are conceived as contributing factors that facilitate the emergence of spatial presence, while calmness is designated as the core reference for its creation in IBVR. The model also incorporates the Spatial Situation Model (SSM), a construct adapted from Wirth et al. (2007), which denotes the user's mental representation of the virtual environment. It is a concept based on the notion that spatial presence is dependent on the allocation of user attention to the mediated environment. However, subsequent empirical investigations by Mohd Muhaiyuddin have shown a non-significant relationship between SSM and other model components.. This finding implies that users can experience a robust sense of spatial presence in IBVR without necessarily constructing a detailed spatial mental model, suggesting the primacy of the three core components. Table 1 shows the elements for the components in SPM4IBVR.

Table 1

Elements for the Components in SPM4IBVR

Components	Elements
Interactivity	Hotspot activity, hotspot with information, auto panning, panning, standardized menu, comfort of navigation
Perceptual Realism	Clear storyline, acceptable storyline, additional object and scenery, animation and scenery, sound and additional object, scenery and sound
Calmness	Calm panoramic view, calm sound

For this study, the SPM4IBVR was integrated with the elements of GIT technique to form a hybrid model for IBVR, specifically for self-therapy. The elements of GIT extracted from existing literatures include *therapist guide, deep breathing exercise, relaxation exercise, natural sound, peaceful nature images, specific details, multiple senses and suggestion for changes*. All components and elements of both SPM4IBVR and GIT were considered in designing and building the proposed hybrid model. As a result, an initial model for IBVR in self-therapy was produced, as illustrated in Figure 2.

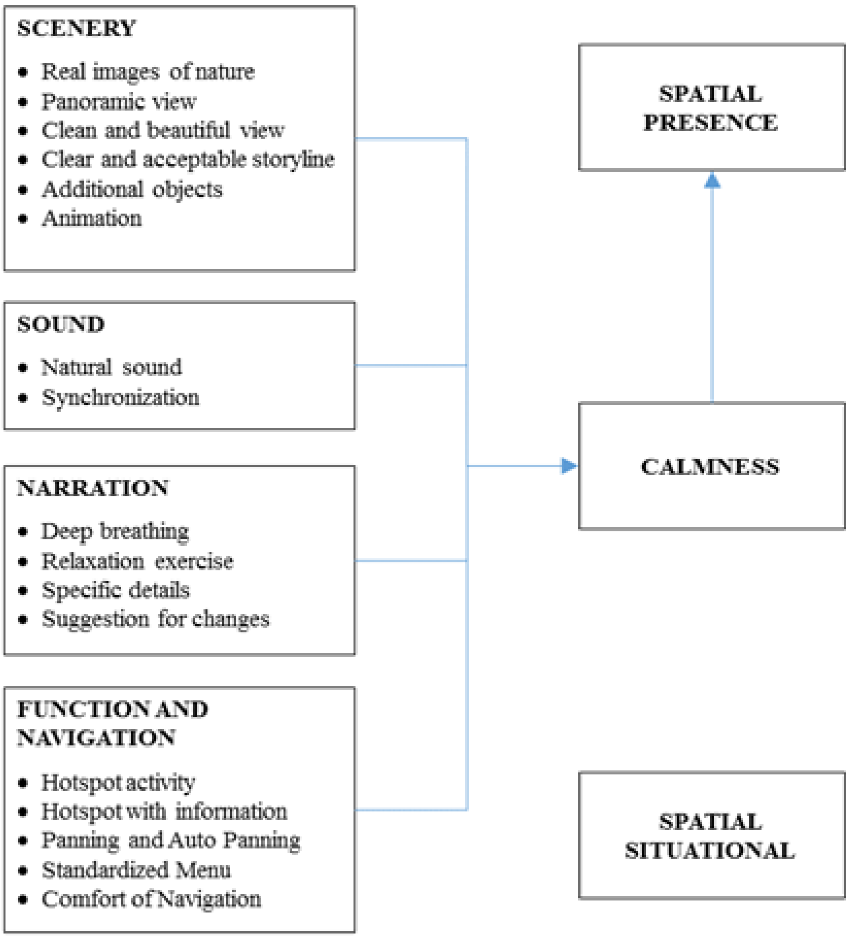

Figure 2. Initial proposed model

According to Figure 2, the components and elements of the proposed initial model are divided into four main categories: *scenery*, *sound*, *narration and, function and navigation*. All these components and elements are linked to a central theme: *calmness*. This sets the foundation that the state of calmness is essential for fostering a sense of spatial presence, especially in IBVR environment. Then, the initial model was validated through an expert review method to verify that it meets the requirements and is reliable for implementation. The aim is to evaluate the proposed model regarding the relevancies of the components and elements and its readability and understandability (Aziz et al., 2024). The experts review the proposed model to identify any loopholes and areas for improvement to ensure that it aligns with the primary objective. In this study, the model has gone through several cycles of expert review involving experts who have expertise relevant to this study. Figure 3 illustrates the expert review process cycles.

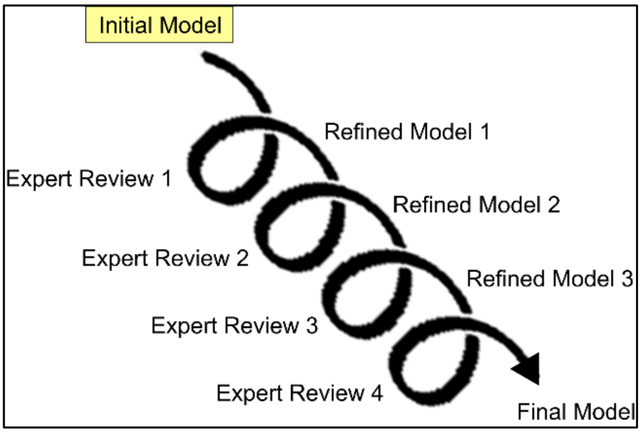

Figure 3. Expert review cycles

In each cycle, the experts reviewed the proposed hybrid model and provided appropriate comments. The review session was conducted through several methods. In the first two cycles, workshop and discussion was held physically with experts who were available at the scheduled evaluation session. Then in the third cycle, the review session were mostly done through emails and online meetings. While in the fourth cycle, the experts review the model through the form and supporting documents provided to them. They were given ample time to review the proposed model and provide their comments in the accompanying review form before returning it via email. In addition, virtual discussions with experts were also conducted through video conferencing to obtain more comprehensive reviews from the experts. Selection of experts were based on the following criteria:

- Have academic qualification (Master/PhD) in related field, either in Multimedia (MM) or Human-Computer Interaction (HCI) or Virtual Reality (VR) or Computer Science (CS) and
- Have experience in teaching/studying/researching/practising MM or HCI or VR or CS field for at least five years

The experts were approached through email that provided a succinct overview of the study. This email also included the review instrument, a detailed description, and a visual illustration of the proposed hybrid model. In response, six esteemed experts agreed to participate and offered their insights into the proposed model. Upon agreement, the experts were given a formal letter of appointment from the faculty to appoint them as reviewers. As a reference, Table 2 presents a detailed demographic profile of each of these experts, highlighting their qualifications and experiences.

Table 2

Demographic Profile of the Experts

Expert	Education	Field of Expertise	Year of Experience
A	PhD	Virtual Environment Design, HCI	29
B	Masters	Games development and testing, UI/UX, assistive technology	23
C	PhD	HCI – evaluation of usability and experience in interaction in various platform	18
D	PhD	VR, Virtual Heritage, AR/XR	20
E	PhD	VR	5
F	PhD	HCI/UX	20

As shown in Table 2, most experts are from VR and HCI fields with academic qualifications at the PhD and master's degrees. Experts A and B have experience in VR design and development, including applications in stress therapy. While expert C has extensive experience in the field of HCI with a deeper interest in evaluation methods for usability and user experience on various platforms, including VR. Meanwhile, expert D's experience is mostly focused on VR with a keen interest in UX in VR design, development and evaluation. Expert E also has interest and experience in VR, especially in the development of IBVR for therapeutic purposes. Whereas Expert F has convincing experience and expertise in HCI/UX with a significant amount of research and industry involvement. These experts are closely aligned with the focus of this study, and their contributions have greatly enriched the design of the model. The following section discusses and analyses the model validation results that was conducted through the four cycles of expert review.

RESULTS AND DISCUSSION

First Cycle

The first cycle of the expert review was conducted with two experts who were gathered in a conducive dedicated room. The session was chunked into briefing, analysing, and de-briefing. In the briefing session, the experts were briefed about the model, the users, and the context of use. Then, in the analysing session, the experts went through the model and provided some comments and suggestions to improve the model. In the debriefing, this study recaps all comments and recommendations outlined by the experts to ensure the experts are satisfied. Among the experts' comments include (1) the model should represent the actual structure of a GIT session to facilitate designers and application developers in developing IBVR applications, (2) the model should incorporate a standard VR design model, (3) the model should have a clear structure so that reading it has a clear flow, (4) every component in the model should be connected, (5) every component should have specific elements, and (6) the model should consider current advancement. In response to the first comment, this study has referred to the existing literature on GIT and identified the structure of therapy sessions most commonly practised in GIT, as shown in Table 3. This structure was then integrated in the proposed hybrid model.

Table 3

Structure of the GIT session

Part	Description
Part 1: Deep breathing and relaxation exercise	Therapist asked the patient to do deep breathing and muscle relaxation in order to help the patient to stay focus and relax.
Part 2: Guided imagery	Therapist asked the patient to imagine peaceful images of nature by involving multiple senses.
Part 3: Suggestion for changes	Therapist give suggestions to the patient for desired changes and coping strategies, based on the problems.

Secondly, for the recommendation on incorporating a standard VR design model, this study has integrated the components for VR development based on existing studies. Fundamentally, there are five basic components of VR that need to be applied in the proposed model as outlined in the literature (Bamodu & Ye, 2013; Górski et al., 2016; Hanson & Shelton, 2008; Zhang, 2017). These components are shown in Figure 4 and are briefly described in the following paragraphs.

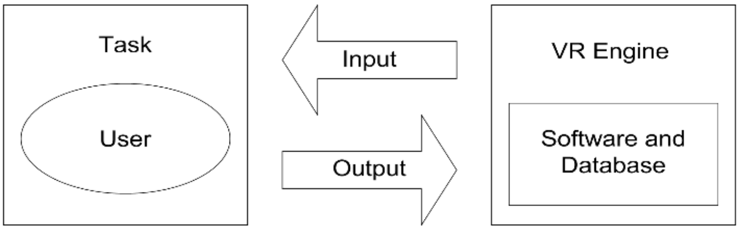

Figure 4. VR system components

1. Task - The user's activity in the virtual world, based on the problem to be solved.
2. User - The human or subject that interacts with the VR system.
3. Input and output
   - Input: Data sent to the computer system based on user's interactions with the virtual environment.
   - Output: Computer rendering of the input from the user based on the interactions.
4. Software and database - Modelling and integration of the objects in the virtual environment.
5. VR engine - The computer architecture to run the virtual environment.

Next, to address the third and fourth comments related to the flow and connection between components, lines and arrows have been placed, connecting related components to show the structure and relationships based on the concepts and theories derived from existing literature. For the fifth recommendation, this study has included the relevant elements for each component in the model, which have been identified through analysis of existing studies. Then, for the reviewer's final comment on current advancement, this study identifies the technologies for input and output in VR that are relevant to this study, particularly for visual and audio. This study uses head-mounted displays (HMD) and headphones as the primary visual and audio output devices. The HMD is also equipped with head tracking ability for panning and auto-panning functions. Also, a controller is used for selecting hotspots and menus. Accordingly, the proposed initial model was revised, as illustrated in Figure 5. Meanwhile, Table 4 summarizes the experts' recommendations and revisions made to the proposed model.

Table 4

Summary of Experts Recommendations and Revision in the First Cycle of Expert Review

No.	Experts' Recommendations	Revisions
1.	The model should represent the actual structure of a GIT session	Refer to existing literature on GIT and identify common structure of the therapy sessions.
2.	The model should incorporate a standard VR design model	Integrate the components for VR development based on existing studies
3.	The model should have a clear structure so that reading it has a clear flow	Related components connected through lines and arrows to show the structure and relationships.
4.	Every component in the model should be connected	
5.	Every component should have specific elements	Include relevant elements for each component in the model, based on existing studies
6.	The model should consider current advancement	Identify the technologies for input and output in VR that are relevant to this study,

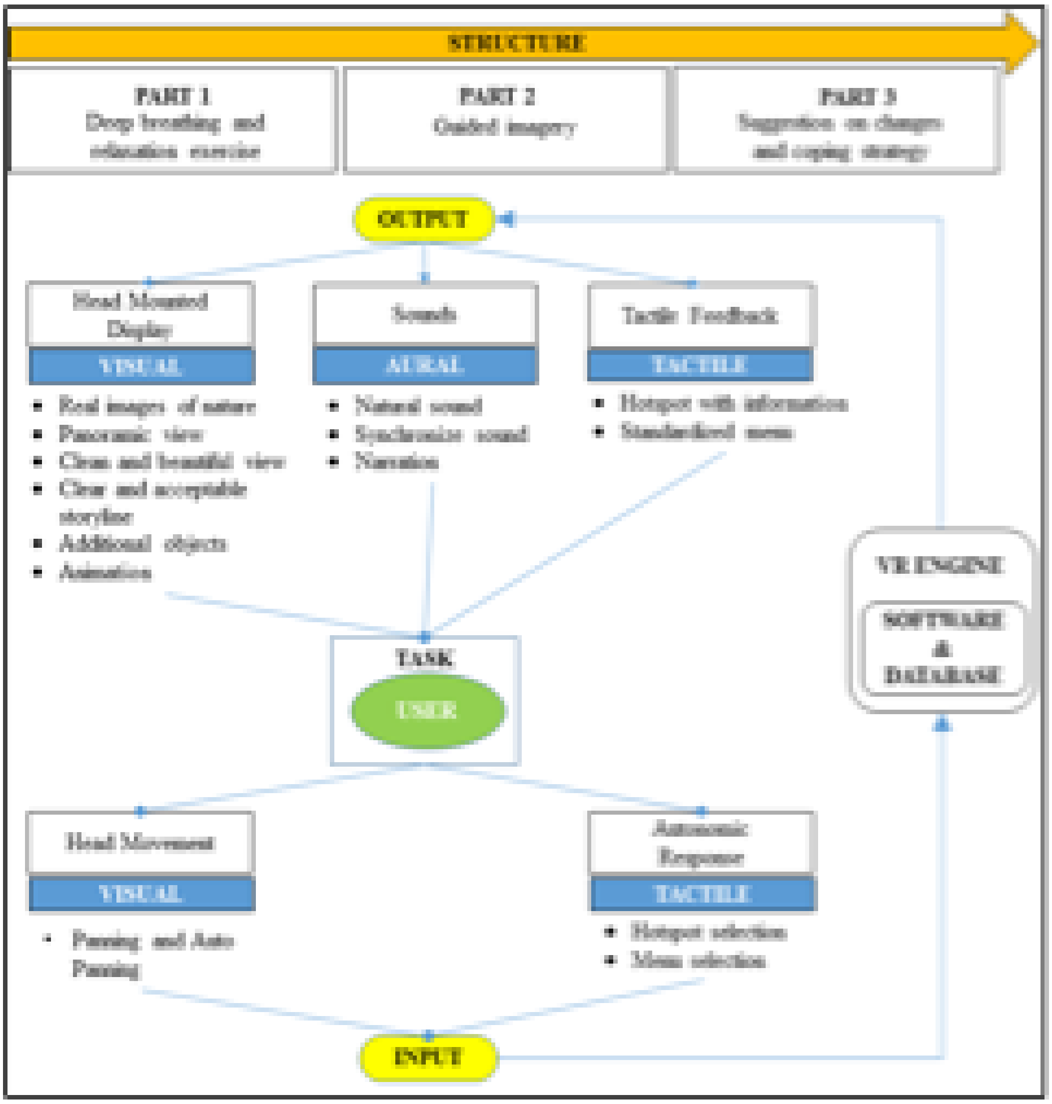

Figure 5. First revised model

Referring to the first revised model as in Figure 5, it provides structural guidance for the implementation of GIT in IBVR based on actual practice. The model also shows the elements involved in the development of self-therapy IBVR based on the five main components in the development of a VR application, namely (1) Task, (2) User, (3) Input and Output, (4) Software and Database, and (5) VR Engine. These components and elements are connected with lines and arrows to show the relationships and dependants among each other. Basically, it shows that the IBVR user provides input to the VR engine through visual and tactile, and the VR engine then give the visual, sounds and tactile output to the user through a Head-Mounted Display (HMD), natural sounds and tactile feedback.

Second Cycle

In the second cycle, the experts re-evaluated the revised model. The aim was to identify any shortcomings and improvements that can be made to ensure that it meets the objectives. The second evaluation was carried out through a workshop in which experts were invited to participate in the discussion. The experts were presented and explained about the refined model using a flipchart, whiteboard and audio/visual system. They were encouraged to ask questions and analyse the model based on the explanation. The questions were mostly on the characteristics of the critical components and elements of the model, as well as the flow and structure. From there, the experts provided some suggestions and recommendations to improve the proposed model. Overall, the experts recommended that (1) the model should highlight the key elements that have been outlined, especially those related to SPM and GIT, and (2) the model should have a more precise flow and structure by showing comprehensible sequences to facilitate understanding of application designers and developers.

In response to the first recommendation, this study has refined the structure of the model, by highlighting the elements of SPM and GIT to be more transparent and substantial, resulted in the generation of four main components of the proposed model, namely (1) Structure, (2) GIT, (3) SPM and (4) VR System, with specific elements to support the effectiveness of IBVR for therapy. These components and elements were generated based on analysis of the existing literature. As for the second recommendation from experts regarding the flow and structure, this study has rearranged the model's design, considering the most suitable arrangement for all the components and elements in the model. This is done by identifying and indicating the relationships between the components and elements. Summary of the experts' recommendations and revisions made is provide in Table 5. It is followed by Figure 6 that illustrates the proposed model after being revised based on expert recommendations in the second evaluation cycle. The main components were numbered accordingly and arrows were carefully arranged to reflect the relationships between components in the model.

Table 5

Summary of Experts Recommendations and Revision in the Second Cycle of Expert Review

No.	Experts' Recommendations	Revisions
1.	The model should highlight the key elements that have been outlined, especially those related to SPM and GIT	Highlights the elements of SPM and GIT more clearly and substantial in the model, with the four main components namely (1) Structure, (2) GIT, (3) SPM and (4) VR System
2.	The model should have a more precise flow and structure by showing comprehensible sequences	Rearrange the model's design, considering the most suitable arrangement for all the components and elements in the model

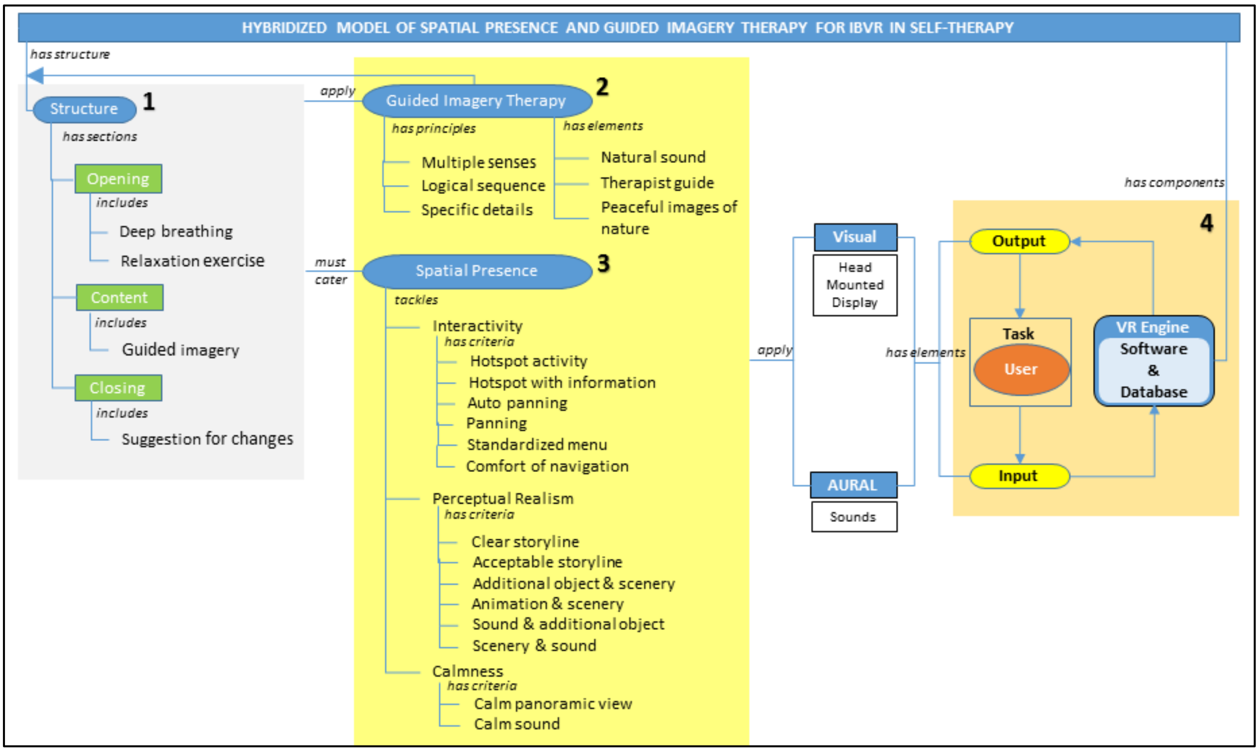

Figure 6. Second revised model

The second revised model more clearly illustrates the four main components of the IBVR self-therapy design model consisting of (1) Structure, (2) GIT, (3) Spatial Presence and (4) VR System. Each of these components contains elements that have been identified and connected by lines and arrows that give a certain meaning. Basically, the model states that the Structure for the implementation of IBVR therapy is an adaptation of the actual GIT session. The development of IBVR therapy should also considers the elements and criteria of Spatial Presence implemented through the VR system.

Third Cycle

In the third cycle, the experts further evaluated the second revised model, as shown in Figure 6. Similarly, the evaluation aimed to identify weaknesses and opportunities for improvement in the proposed model. Communication with the experts was conducted through emails and online meetings. They were provided with descriptions and illustrations of the proposed model and the instruments for assessment. During the online meeting, experts have asked relevant questions for further clarification. Apart from the evaluation instruments, they were also allowed to provide independent comments and suggestions based on their expertise. Overall, in the third evaluation cycle, experts have recommended that (1) the components in the model should be detailed and described further by showing the difference between compulsory and recommended components and (2) the components and elements of the model are too general and vague.

In response to the first recommendation, further analysis has been conducted to identify the generic components and elements of the proposed model based on existing models. The components and elements were selected according to conditioning rules to classify whether the components are compulsory or recommended to be applied. Based on the conditioning rules, the generic components and elements of the proposed model were identified through a comparative analysis of existing models.

The analysis was conducted to see similarities and differences between the models regarding their generic components. Based on the results of the comparative analysis, the generic components were then summarised and classified to determine the compulsory and recommended components for the proposed hybrid model, as shown in Table 6 and Table 7.

Table 6

Classification of Generic Components for GIT

Generic Components	Classification
Therapist Guide	Compulsory
Deep breathing	Compulsory
Relaxation exercise	Recommended
Multiple senses	Compulsory
Natural/Ambient sounds	Recommended
Images of peaceful nature	Compulsory
Image variation	Recommended
Specific details of images	Compulsory
Client-based	Recommended
Coping strategies	Recommended

Table 7

Classification of Generic Components for VR System

Generic Components	Classification
VR engine	Compulsory
Software	Compulsory
Database	Recommended
Input	Compulsory
Output	Compulsory
User	Compulsory
Task	Compulsory

In addition, experts have commented that the components are too general and vague. They argue that the components need further detail and explanation to facilitate the understanding and effectiveness of the proposed model. Therefore, this study has reviewed the components by making more in-depth references to documents and descriptions of existing models for further understanding and better adaptation. Table 8 shows the summary of the experts' recommendations and revisions made in this cycle of expert review. Eventually, the third cycle of the expert review process resulted in the revision and refinement of the proposed design model for IBVR self-therapy, as illustrated in Figure 7. The third revised model includes a more detailed representation of the components and elements and rearranges connections and arrows to make the relationships between components more apparent. This is also a response to the recommendation by the experts in this third cycle of expert review, who suggested that the relationships between components in the model should be transparent to ensure that the model is readable and easy to understand.

Table 8

Summary of Experts Recommendations and Revision in the Third Cycle of Expert Review

No.	Experts' Recommendations	Revisions
1.	The components in the model should be detailed and described further by showing the difference between compulsory and recommended components	Conduct comparative analysis of existing studies to identify generic components for the proposed model and classified as compulsory or recommended
2.	The components and elements of the model are too general and vague	Make more in-depth references to documents and descriptions of existing models

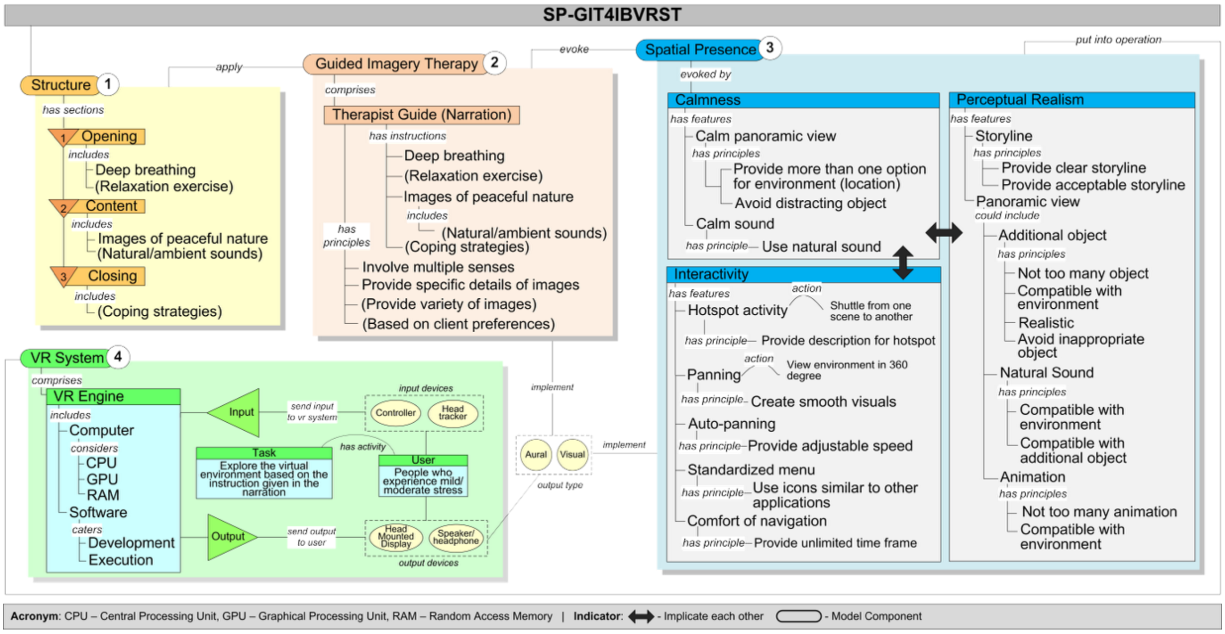

Figure 7. Third revised model

Referring to Figure 7, the third revised model illustrates a more comprehensive and understandable figures that shows the main components and elements of the design model for IBVR self-therapy. The components are clustered and arranged in an organized representation, with detailed illustration of the important elements and principles for the design and development. This will be described in more details according to the final revised model in the next subsection.

Fourth Cycle

Then, the third revised model was re-evaluated in the fourth cycle of expert review to evaluate the relevancies of the components and elements and the readability and understandability of the proposed hybrid model. The experts were provided with the review instrument, along with an illustration and description of the proposed model. They were given adequate time to review the proposed model and provide their comments in the accompanying review form before returning it via email. In addition, discussions through video conferences were also implemented to get a more comprehensive review from the experts. The video session was recorded, documented and verified by the expert for future references. Based on the experts' comments and recommendations, refinement was made to the proposed model. On average, the fourth cycle of the expert review process takes about one to two months to complete.

The expert review instrument is in the form of a questionnaire. Part I of the questionnaire contains questions on demographic data. Part II questions are related to (i) the relevancy of the components and elements, (ii) the understandability of the terms used and (iii) the readability of the proposed model, which reflect the objectives of the expert review. Experts determine the relevancy of each component and element by choosing one of the options, either "some are not relevant", "some may not be relevant", or "all are relevant". Also, there are three statements regarding the understandability of the terms used, the logic of the flows and the overall readability of the model. Experts determine whether they agree or disagree with the statements by choosing "yes" or "no". Finally, the experts are requested to provide their overall perceptions and suggestions for improvement based on their expertise and experience. The collected data are tabulated in Table 2 and Table 3. Table 2 shows the frequency of expert feedback regarding the relevance of components and elements in the proposed model. Table 3 shows the frequency of feedback on the understandability and readability of the proposed model.

Table 2

Frequency of Experts' Feedback on the Relevance of Components and Elements in the Proposed Model

Items			**Frequency (n=6)**		
No.	**The proposed components and elements are relevant?**		**Some are NOT relevant**	**Some may not be relevant**	**All are relevant**
1.	Structure	Opening	0	0	6
		Content	0	0	6
		Closing	0	0	6
2.	Guided Imagery Therapy	Therapist guide (narration)	0	0	5
3.	Spatial Presence	Calmness	0	0	5
		Perceptual realism	1	0	4
		Interactivity	0	0	5
4.	VR System	VR Engine	0	0	4
		Output	0	0	4
		Input	0	0	4
		User	1	0	3
		Task	2	0	2

Table 3

Frequency of Experts' Feedback on the Understandability and Readability of the Proposed Model

No.	**Items**	**Frequency (n=6)**	
		Yes	**No**
5.	The terms used are easy to understand	5	0
6.	The relationships and flows of all the main components and sub-components are logical	5	0
7.	Overall, the design model is readable	5	0

Referring to Table 2, most experts agree that the proposed components and elements are all relevant. This directly reflects the first objective of the expert review, which is to evaluate the relevancy of proposed hybrid model. Although several experts also responded that 'some are not relevant' for some elements in Spatial Presence and VR Systems, they have supported their answers with appropriate comments and recommendations. Table 3 shows that all experts have chosen a 'Yes' answer for all three statements, except for one expert who has not given any feedback. Thus, it can be concluded that most experts agree that the terms used in the model are easy to understand, the relationship and flow of the model are logical, and the model as a whole is readable. This feedback gives positive input and fulfils the second objective of the expert review, which is to evaluate the comprehensibility and readability of the proposed model. Additionally, experts have also provided comments and suggestions to improve the proposed model. Table 4 summarizes the experts' comments and recommendations for each item of the review instrument and other general recommendations.

Table 4

Summary of Experts' Comments and Recommendations

No.	Items	Comment and Recommendation
1.	Structure	-Experts recommended that the therapy session to be conducted only in one location to avoid distraction should they are given the option to change location during the session. -The representation of the Structure component was inadequate. It is recommended that the term 'Structure' to be revised to indicate the flow of the IBVR. -The content of the Structure component is related to GIT and Spatial presence. Therefore, the interconnection of these components should be visualised in the proposed model.
2.	Guided Imagery Therapy	-Experts' comments are mainly related to the implementation of the narration or the therapist guide. -Experts argued about the ordering of activities in GIT and the appropriateness of the 'coping strategies' element.
3.	Spatial Presence	-Experts argued about the criteria for calm images that were not adequately represented in the proposed hybrid model. -Most experts disagree with the Storyline element as part of the Spatial Presence component because they didn't see its significance. Also, the auto-panning function seems irrelevant because users can independently view the environment in 360 degrees through the HMD.
4.	VR System	-Some experts commented that the User and Task elements are insignificant.
5.	Other	-Some experts suggested that some technical terms could be simplified to better understand the model. The relationship between components needs more justification and explanation should be added for elements not included in the inscription.

Justification of Expert Feedback

Structure

In response to experts' recommendation on the Structure component, this study agrees that during the therapy session in the IBVR, users should be presented and guided for therapy in only one location per session. It aims to avoid users losing focus if they are given multiple choices during that session.

Therefore, a new element has been included to indicate an activity where users must select their preferred location before proceeding with a therapy session. Also, it can be concluded that deficiencies in the representations and descriptions of the Structure component have caused experts to be slightly confused about its actual context. Accordingly, this study has made amendments by providing a more precise description of the activity or element within the Structure component. This includes renaming the component title from ‘Structure’ to ‘Content Structure’ to indicate the actual context and function of the element. This study identifies that emphasizing the interconnection between the first component and the other components in the model will increase the readability and understandability of the proposed design model. Hence, this study has placed appropriate arrows in the proposed model as additional connections to show the relationship between the Content Structure component and the GIT and Spatial Presence components.

Guided Imagery Therapy

Experts' comments on GIT component are more about implementing the narration or therapist guide in the IBVR for self-therapy, as proposed in this study. This indicates that the descriptions of the components and elements for GIT in the proposed model are insufficient, leading to some uncertainty. Thus, this study has made appropriate changes in the representation of the model by providing more descriptions of the GIT component and its elements. This also consists of the changes in response to the experts' comments regarding the implementation of deep breathing, relaxation exercises and coping strategies as part of the GIT. More detailed descriptions have been added to the GIT component to describe the activities involved in the IBVR self-therapy.

Spatial Presence

The comments and recommendations for the Spatial Presence component are mainly focused on the elements and their details, which are seen to be insufficient to fully represent the Spatial Presence component in the proposed design model. It implies that the Spatial Presence component may not be well understood by the application designers and developers, who are the target users of the proposed design model. Thus, this study has made further analysis through existing literature to identify the characteristics of images that are considered calm. Referring to the generic components of the GIT, one of the characteristics of the therapy is the ‘peaceful nature images’. It implies that during the actual GIT session, the therapist will guide the patient to visualize a peaceful nature scenery to provide a feeling of relaxation and thereby reduce stress. This is also in line with the findings in previous studies which state that images of natural scenery are able to provide calmness and subsequently reduce stress levels (Nanda et al., 2012; Brown et al., 2013; Mochizuki-Kawai et al., 2020). Therefore, this study decided to include the ‘peaceful nature images’ as part of the characteristics of the calm images in the Spatial Presence component.

This study also agrees with the experts’ concern about the relevance of Storyline and Auto-panning elements in the spatial presence component. The IBVR self-therapy in this study does not involve continuous scenes that make up a story. Therefore, the term storyline is not seen as very appropriate to use. This includes the elimination of the Hotspot element as it is directly related to the Storyline, and they implicate each other. Also, this study sees the auto-panning function as irrelevant because the HMD allows users to move their heads in all directions or control the panning function themselves to see the displayed scene. For that reason, both Hotspot and Auto-panning elements are removed from the proposed model, specifically from the spatial presence component.

VR System

It can be observed that there are not many comments or suggestions from experts regarding the elements of the VR System component. This indicates that the component and its elements are acceptable in the proposed design model. Although some experts commented that the User and Task elements are not significant, this study decided that these two elements should be retained as they provide an overview to the application designer and developer about the users and the activities involved in the IBVR development. These elements have been classified as 'compulsory to be applied' based on the comparative analysis done earlier in this study. Overall, no changes or amendments were made for the VR system component in the proposed model.

Other

In response to the experts' concerns on the understandability of the proposed model, this study has taken steps to simplify some of the terms used and modify the arrows to show a more coherent relationship between the components in the proposed model. This also includes improvements to indicators or legends that provide explanations to the model illustration.

The Final Revised Model

Finally, after all the items in the expert review instrument were analysed and experts' suggestions were considered for improvement, Figure 8 shows the final model resulting from the four cycles of the expert review process. The final revised model exhibits more relevancies of the elements and components, readability and understandability of the proposed hybrid model of spatial presence and GIT for IBVR in self-therapy.

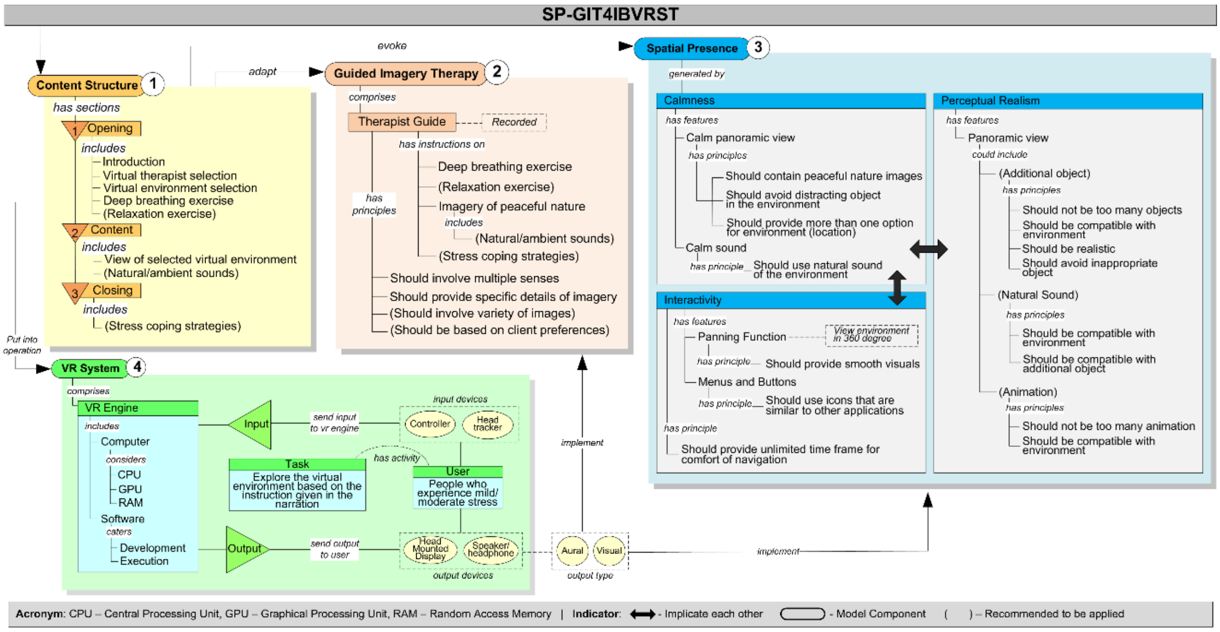

Figure 8. Final revised model

According to the revised model in Figure 8, the model comprises four main components, namely (1) Content Structure, (2) Guided Imagery Therapy, (3) Spatial Presence, and (4) VR System. The ***Structure*** component dictates that the content of the IBVR self-therapy tool is divided into three sections, namely opening, content and closing. In the opening sections, a brief introduction to IBVR self-therapy is provided, before proceeding with the selection of virtual therapist and environment. The virtual therapist will guide the user throughout the therapy session, including the deep breathing exercise. Then the user will navigate through the selected virtual environment and be guided for stress coping strategies. All of these activities are adapted from actual GIT session, as shown in the ***Guided Imagery Therapy*** component, which mainly consist of therapist guidance in a recorded voice that direct the user for the imagery therapy. There are also principles that should be adhered to ensure the effectiveness GIT implementation in IBVR self-therapy. Among others, it further necessitates the engagement of multiple user senses and the use of diverse, detailed imagery for the IBVR tools.

While the ***Spatial Presence*** component indicate that the IBVR should be able to evoke a sense of spatial presence to make users feel as if they are physically present in the virtual environment. This characteristic is crucial in ensuring the effectiveness of the IBVR self-therapy tool. The model shows that the Spatial presence can be generated through the application of calmness, interactivity and perceptual realism in the virtual environment. The calmness can be evoked through panoramic view and natural sound. While interactivity in IBVR can be achieved through panning function, standardized menus and unlimited timeframe. To foster perceptual realism, the IBVR self-therapy requires a panoramic view, supplemented by the strategic inclusion of additional objects, ambient natural sounds, and subtle animations within the environment. Finally, the ***VR System*** component outlines the essential hardware and software considerations for development, encompassing computational specifications, software platforms, and input/output devices. Overall, the components and elements depicted in the proposed model are significant in the development of IBVR for therapeutic purposes.

CONCLUSION

The objective of this study is to establish a design model for the implementation of IBVR in self-therapy, with a particular focus on stress conditions. The model is built on spatial presence theory and the GIT technique as the fundamental framework for achieving the study's aims. This paper discusses the development and validation of the proposed model through an iterative expert review process. The expert review aimed to assess the relevance of the elements and components, as well as the readability and comprehensibility of the model. Based on the outcomes of the expert review, refinements were made to the proposed model before it was deemed ready for user evaluation and practical use. The model is poised to be advantageous for application designers creating IBVR tools for self-therapy. The IBVR device to be developed is anticipated to contribute as an alternative mental health intervention, offering a potential means of promoting psychological well-being and reducing stress within the community. Nevertheless, the proposed design model for IBVR self-therapy was developed based on a broad perspective which takes into account stressful situations in general. Future research should prioritize the validation and refinement of the model across a wider range of high-stress environments, including correctional facilities, medical settings, and disaster relief shelters. Furthermore, the model's scope can be expanded to encompass diverse cultural and national contexts. It is anticipated that the effects of implementing specific components may vary according to situational and demographic factors, requiring sensitive cultural and environmental adaptations..

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CONFLICT OF INTEREST

The authors declare no conflict of interest

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