TOWARDS THE DESIGN AND DEVELOPMENT OF A 3D VIRTUAL PSYCHOLOGICAL SELF-SERVICE PLATFORM FOR OCCUPATIONAL STRESS (RESEARCH-IN-PROGRESS)

Manning Li
Northeastern University, mnli@mail.neu.edu.cn

Xuan Wang
Northeastern University, xuanwang.neu@gmail.com

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Manning Li, School of Business Administration, Northeastern University, Shenyang, Liaoning, China, mnli@mail.neu.edu.cn

Xuan Wang, School of Business Administration, Northeastern University, Shenyang, Liaoning, China, xuanwang.neu@gmail.com

Abstract

With dynamic changes in the modern society, people in high-stress occupations face with growing psychological pressure. It is highly imperative to design and develop a 3D virtual psychological self-service platform for people in high-stress occupations to increase their access to timely psychological support and advice. Guided by the design science paradigm raised by Gregor and Hevner, we present the design and implementation methods of our VPS system as well as its theoretical and practical significance. This study, through delivering psychological self-services in self-constructed virtual worlds, aims at systematically examining the viability and optimal design strategies for VPS to support busy health consumers in relieving their occupational distress. In the follow-up studies, we will conduct large scale experiments involving questionnaires, interviews, heart rate monitors and eye-trackers to gain a more comprehensive understanding of the potential impacts of this 3D virtual psychological self-service platform.

Keywords: Virtual Psychological Self-Service, Occupational Stress, Virtual World, Virtual Reality, System Design Principles.
1 INTRODUCTION

With the increasing pace of life, people especially those in high-stress occupations face with growing psychological pressure. The WHO reported in 2010 that over 25% of world population have or once have experienced mental and psychosocial issues (WHO, 2010). It is estimated that the number of people suffering from depression reaches 151 million in 2010 (WHO, 2010) and swells to 350 million in 2012 (WHO, 2012). Spreading across all age group, depression is estimated to be more and more severe in the future and will be the second highest cause of disease burden by 2030 (WHO, 2010). Reported health issues related to high-stress from workplace include cardiovascular disease, high blood pressure, high blood sugar, and high cortisol levels. Many psychological issues such as depression can be reliably diagnosed and effectively treated. Yet only less than 50% of those people in the world (less than 10% in some countries) receive proper medical treatment. Also, many people feel ashamed to seek for support due to social stigmatization. In other situations, a large number of people failed to be treated because of the limited or even unavailable medical resources. Others shrug off their symptoms and end up suffering in silence. Contrary to some misconceptions, depression is neither inevitable nor a character flaw (CANMAT, 2012).

Virtual Psychological Self-service (VPS) platforms can be a handy way to provide timely support for people in high-stress occupations, such as emergency rescuers or medical professionals (Berger et al., 2012) who may occasionally suffer from emotional outbursts or other psychological issues. Such platforms would help people discover their problems, recollect their inner thoughts, understand themselves better and improve their mental well-being. It can also serve as a complementary tool for existing counselling services. Virtual world is a promising tool for the psychological self-service domain. A recent study shows that electronic games in 3D environment implemented through social networking sites appear to effectively enhance users’ mental health literacy (Li et al., 2013). Such environment avoids the embarrassment people may experience while visiting psychologists in person. It also creates an ideal vivid presence for people to receive a therapy which often requires minimum interruptions from the external world.

Existing virtual psychological self-service systems are mostly developed on 2D platforms (HKJC Centre for Suicide Research and Prevention, 2004), or 3D environments with limited interactions with the user (e.g., see virtual advisors in Second life as discussed in (Boulos et al., 2007; Li & Buchthal, 2012)). In addition, most research in the 3D virtual psychological self-service area focus on the system artefact or therapy outcome per-se from a medical practitioner’s view. Little study has uncovered what really matters to virtual world psychological self-service system users from the HCI perspective. Systematic and empirical studies guiding the design principals from the user’s perspective are limited. Further, studies concentrating on the psychological need of high-stress professional people are even scarcer. This study aims at remedying these insufficiencies in the system design and filling this gap in literature on the design of 3D VPS platforms.

Consequently, we seek to explore: what are the important aspects in the VPS system design that impact on its value for users?

Based on this understanding, we narrow our targeted population of our VPS system to people in high-stress occupations. Guided by the findings from practice and extant literatures, we designed and developed a 3D VPS platform for these needy people. In the following sections, we will explore the theoretical background which includes a review of literature in virtual psychological self-service domain and the effect of VPS on users based on empowerment theory (Zimmerman, 2000). Then, we present our VPS platform and discuss its design principals. The implementation methods of the system are also briefly discussed. Finally, we discuss the next-stage of this on-going research project.

2 THEORETICAL BACKGROUND

2.1 Virtual world as an effective psychological self-help tool to support professional people

Psychological self-help is a process in which people proactively involve in maintaining their mental health through observing, evaluating and empowering themselves to acquire relevant knowledge, develop coping skills and exploit the potential for personal psychosomatic development (Zhong et al., 2008). Although psychological self-services are under dynamic development in military research labs or
university departments, and many theoretical and practical challenges are still to be resolved at present, many new opportunities are made possible through technological innovations. Such as the increasing popularization of intelligent end-user mobile devices and web 2.0 technologies. It is a consensus by the research community that people can avoid and reduce the negative emotional state, delay, reduce and even eliminate the psychological conflict and promote healthy personality through positive self defence mechanisms (Freud, 1997; Frost, 2008). In the recent years, some psychology specialists also openly expressed support for the potential value of psychological self-help services for the general public (Mellor & Yeomans, 2008; McNally, 2011; Barlow et al., 2013).

This prediction is congruent with the current trend in many countries in the world (see Table 1), VPS has increasingly become an effective way for people to release their psychological pressure and improve psychological conditions. Increasingly, researchers in many countries are also exploring a number of psychological self-service platforms to engage people in learning psychological knowledge, to help them address psychological problems and to provide timely support or therapies through various innovative ICT technologies(Frost, 2008). To gain a better understanding of the extant work on virtual psychological self-service systems, we summarize the forms, system objectives and functions of several representative virtual psychological self-service systems in use by the public or as documented in literature (see Table 1).

<table>
<thead>
<tr>
<th>System Type</th>
<th>System Name and Study</th>
<th>Function/Techniques</th>
<th>System Preview</th>
</tr>
</thead>
</table>
| Audio CDs / DVDs / Videos/Flash animations | Good Days Ahead (Wright et al., 2014)             | • Demonstrate negative and positive behaviours and thinking patterns (DVD).  
• Teach self-help techniques.  
• Blend videos, graphics, and stimulating self-help exercises in this online program that help user make positive changes in how they think and feel. | ![Image](image1.png) |
• Introduce fundamental psychology.  
• Mental relaxation.  
• Emotion management.  
• Provide mental health course or courseware. | ![Image](image2.png) |
| 2D Interactive website or web-based applications | MoodGYM (CMHR, 2004)                              | • Provide cognitive behaviour therapy skills for depressed people and offer activity scheduling, relaxation therapy, problem solving technique.  
• Consists of an interactive game, anxiety and depression assessments, downloadable relaxation audio, a workbook and feedback assessment.  
• Flashed diagrams and online exercises to teach the principles of cognitive behaviour therapy. | ![Image](image3.png) |
|                                  | Depressed Little Prince (HKJC Centre for Suicide Research and Prevention, 2004) | • Introduce fundamental psychology.  
• Psychological self-test.  
• Point to emergency hotlines and supporting resources.  
• Send E-mail to depressed people to encourage them.  
• Library of psychology knowledge. | ![Image](image4.png) |
|                                  | Beating the Blues (Proudbfoot et al., 2003)       | • Use Cognitive Behavioural Therapy (CBT).  
• Flash animations to demonstrate the symptoms of anxiety and depression.  
• Courses help understand the link between how people think influences their feelings and behaviours.  
• Print off summary progress reports | ![Image](image5.png) |
Table 1. Forms, system objective and function of virtual psychological self-service platform

<table>
<thead>
<tr>
<th>Virtual (Reality) Environments</th>
<th>Online Anxiety Prevention Project (The University of Queensland)</th>
<th>Second Life (Brekel, 2009)</th>
<th>Virtual Reality Medical System (Virtual Reality Medical Center, 2011)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Use Cognitive Behavioural Therapy (CBT).</td>
<td>Offer virtual counselling and conversational interaction to provide preliminary diagnoses and suggestions.</td>
<td>Use 3-dimensional computer simulation in combination with physiological monitoring and feedback to treat panic and anxiety disorders.</td>
</tr>
<tr>
<td></td>
<td>Focus on education and training to help people continue managing their anxiety and stress levels in a wide range of situations.</td>
<td>Provide newcomer orientation and self-help resources.</td>
<td>Integrate hardware, software, realistic scenarios and diagnostic tools &amp; features to meet the needs of the therapist and the patient.</td>
</tr>
<tr>
<td></td>
<td>Psychological self-test.</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Schedule management.</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Based on insights from the list of examples in Table 1, we can see that:

Although existing research has obtained great progress in engaging people in learning psychological knowledge and supporting them with their psychological issues, there still exist considerable space for further innovation and improvement. Existing virtual psychological self-service systems are either 1) videos with monotonous virtual self-service functions, 2) stand-alone applications which do not allow easy and timely access, 3) 2D websites or web applications with limited user experience, or 4) 3D environments with little system-user communications and interactions. Much work are still to be done to enhance the psychological self-service systems to give users a better sense of social presence and control to empower them in their self-help processes.

Boulos et.al (2007) found that it is imperative to apply virtual world technologies to medical and health related domains to create a more attractive and personal atmosphere for users. He also claim it to be the development trend in the future. This has inspired us to design a VPS platform targeting at high-stress professionals in the virtual world.

Compared with 3D virtual psychological self-service systems currently in existence (e.g. see second last row in Table 1), our platform contains more comprehensive functions and richer set of human-computer interactions in system design. For example, except for ordinary functions (e.g. knowledge of psychological self-help; communicating with characters in the virtual world; virtual psychological counselling), which have been applied to the virtual world, we introduced more comprehensive functions in our platform to empower people to conduct psychological self-help with more fun and sense of immersion. Examples of such functions include e-books and courses, self-tests, library of psychology knowledge, emotion management trainings. Besides, abundant of system-user interactions make our VPS platform more entertaining and users can experience more sense of control.

In addition to incorporating more comprehensive and interactive functions, a scientific design methodology for VPS is considered equally important in design science research (Gregor & Hevner, 2013). By consciously introducing scientific research methodologies and enhancing the advisability of design patterns, the VPS design artefact will not only add value to practice, but also contribute to the existing knowledge base in the design of virtual psychological self-help systems.

2.2 Theories underpinning of the design of virtual psychological self-service platform

Psychological self-service aims at empowering depressed patients gain mastery over issues of concern and feel a sense of control by more involved in decision-making (Zimmerman et al., 1992; Zimmerman, 1995). The psychological self-help process can be achieved through different ways (e.g., independent systems or web-based applications) and different self-service methods (e.g., consultation, cerebral training, psychological tests, advisory simulation tasks) no matter at what time and place (Proudfoot et al., 2003; HKJC Centre for Suicide Research and Prevention, 2004; HYPRG, 2013). This inspires our
study towards helping people in high-stress occupations with their psychological problems by forms of psychological self-service.

Virtual world refers to a computer-based, simulated multi-media environment with unique affordances for communication activities (Jarvenpaa et al., 2007; Mennecke et al., 2011). Compared with other forms of system, it enhances intimate relationship and fosters rich interaction (Mennecke et al., 2011). Virtual world can also provide better user experience in a more novel and intuitive way (Berger et al., 2012). People can participate in it to do things and realize the interaction as in the real world through forms of avatars (Messinger et al., 2009). In another study, Boulos et al. (2007) found that access to medical and health related educational applications are not remote possibilities through virtual worlds. These research prove the importance of using virtual world to create a more attractive and personal atmosphere and motivates our study towards the forms of virtual worlds applied to the psychological self-service domain.

The empowerment theory summarized in (Li & Gregor, 2010; Li & Gregor, 2011) fits the purposes of our 3D VPS platform due to its wide applications in the psychological self-help domain. The term “empowerment” first emerged as an identifiable concept in the social science literature (Mulledger & Ward 1991) and has been extended defined and systematically studied in areas of psychology (Perkins & Zimmerman, 1995; Zimmerman, 1995) as well as medical science and nursing (Gibson, 1991; Rodwell, 1996; Laschinger & Finegan, 2005). The empowerment phenomena in psychology medical science and nursing area can be understood through three main components: antecedents, key dimensions and consequences. The consequences include self-efficacy, a feeling of hope, perceived connectedness (i.e. social presence), more involved in decision-making (i.e. a sense of control) and self-development (e.g. being more informed, skilled, healthy). The empowerment antecedents are opportunities for participation (e.g. important tasks), personalized services, transparency (i.e. easy to understand), skill development (i.e. relevant to access to resources and education) and emotional support.

According to empowerment theory and related literature, interactions including personalized greetings, socially rich text contents (Gefen & Straub, 2003), human audios (Lombard et al., 1997) or videos (Kumar & Benbasat, 2006), virtual psychologists (Kavakli et al., 2012) in virtual worlds can encourage social presence. The situation that users see a closer correspondence between goals, gain greater access to and control over resources, given opportunities to control their own destiny and influence the decisions that affect their life may bring user a sense of confident and feel controlled with their own fortune (Cornell Empowerment Group, 1989; Zimmerman, 1990; Mechanic, 1991). These also supported by abundant of literatures (Short et al., 1976; Rice, 1993; Gunawardena, 1995; Berger et al., 2012).

In sum, these above discussions help us gain a better understanding of the role of VPS and clarify how such innovative information technologies were applied to domain of psychological self-services and how users are empowered as a result of using them. In particular, it points out the direction for how we should design and develop our system prototype to bring users a better sense of social presence and control.

3 SYSTEM DESIGN

3.1 System Design and Development Methodology

In order to enhance user’s sense of immersion and reality in this virtual roaming system, the design and development methodologies of our 3D platform for social interactions consulted abundant literature (Pandzic et al., 1995; Witmer & Singer, 1998; Dickey, 2005). Along with the development of 3D modeling technologies, the integration of 3Ds Max and Unity3D tools are presently considered effective strategies utilized by millions of developers and video game publishers. We utilize powerful functions and characteristics of 3Ds Max and Unity 3D to establish the 3D virtual environment. Interactions (e.g., third-party virtual roaming, pop-up widgets with advisory messages, virtual counselling and other interactive functions) in our 3D VPS platform are realized mainly through two ways: 1) Use scripting language (e.g., JavaScript, C#, Boo) supported by Unity 3D to realize such functions. For example, we combine C# language and Unity AIT (artificial intelligence technology) to achieve the automatic path-finding functions and the artificial intelligence Chabot of avatar. 2) Use plug-ins of Unity 3D to achieve human-computer interaction. For example, we use the NGUI plug-in to prompt guiding messages in
different scenes in VPS. The design and development methodologies of our system, which are based on three design science research cycles as discussed in Gregor and Hevner (2013) are shown in Figure 1.

![Design Science Research Diagram](image)

**Figure 1. Design and Development Methodology of System**

*Image based on Gregor and Hevner 2013*

In this iterative way, we can achieve a balance in all dimensions and improve modelling efficiency. In addition, the 3D VPS platform can be deployed to various system platforms (e.g. Windows, Android, or iOS) which allow users to know and learn the related knowledge of coping with stress and find their psychological problems through the platform whenever and wherever possible.

### 3.2 The Overall Layout of 3D Virtual Scene

Our 3D virtual psychological self-service platform contains four stages namely lost, explore, quest, awakening and growth. There are six scenes including “Lost Valley”, “Psychological Dictionary”, “Exploring Mirror”, “Broken Bridge of Mind”, “Psychological Health Care Center”, and “The Looking Up of Happiness”.

![Planform of 3D Virtual Scene](image)

**Figure 2. The planform of 3D virtual psychological self-service platform**

The design of the scene of 3D VPS platform and “Psychological Health Care Center” are shown in Figure 2. The primary structure of this system is: first, a storyline is introduced via animated contents at the beginning, reflecting the inner world of people in high-stress occupations; following the video is the 3D system interface. System main scene is the 3D virtual environment we established, which takes a path as the central spindle, and stands for the progress of a stressed patients seeking for support to overcome his mental illness, waking up and achieving his spiritual growth and finally enjoying his joyful inner peace after experiencing dilemma, exploration and seeking for a way out. We set different scenes on both sides of the road according to the mental experience of the users to help demonstrating the mental journey of them in an ingenious way. Avatar can realize virtual roaming on the road, and a psychological self-help service is offered in the scenes. The main functions of our 3D VPS platform is shown in Table 2.
<table>
<thead>
<tr>
<th>Stage</th>
<th>Scene</th>
<th>Self-service Function</th>
<th>Implementation Effect of Scene</th>
<th>Design Consideration</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lost</td>
<td>Lost Valley</td>
<td>• This is the first scene, a user enters upon successful log in.&lt;br&gt;• User should register before entering our system to establish personal e-record and manage their emotion.&lt;br&gt;• User can customize system language, we have now provided two languages including English and Chinese.</td>
<td><img src="image1.png" alt="Image" /> • Symbolize the inner world of people in high-stress occupations with bad mood.&lt;br&gt;• Use virtual world to create a more attractive and relaxed atmosphere and realistic scenario for user.&lt;br&gt;• Use 3Ds Max and Unity3D to establish 3D environment</td>
<td><strong>User gains greater access to control over amass resources here.</strong>&lt;br&gt;<strong>Controlling actions and facial expressions of user’s avatar in the system can bring them a sense of control.</strong></td>
</tr>
<tr>
<td>Explore</td>
<td>Psychologi cal Dictionary</td>
<td>• Introduction of fundamental psychology (e.g. therapeutic methods and self-help knowledge).&lt;br&gt;• E-library of psychological knowledge.</td>
<td><img src="image2.png" alt="Image" /></td>
<td><strong>Human-computer interactions and personalized elements in 3D VSP platform to make users feel sense of support.</strong></td>
</tr>
<tr>
<td>Explore</td>
<td>Exploring Mirror</td>
<td>• Psychological self-test.&lt;br&gt;• Provide preliminary diagnoses and suggestions.&lt;br&gt;• Print off feedback assessment to show to their GPs.</td>
<td><img src="image3.png" alt="Image" /></td>
<td><strong>Symbolize the depressed patient begin seeking spiritual awakening in the path of mental growth.</strong>&lt;br&gt;<strong>Warm prompts in science enhance the user’s self-efficiency and bring them sense of social presence and connectedness.</strong>&lt;br&gt;<strong>The design of a little elf is to get people feel like regaining sense of control after some effort to boost user’s sense of self-efficiency.</strong></td>
</tr>
<tr>
<td>Quest</td>
<td>Broken Bridge of Mind</td>
<td>• Messages that encourage and instruct users on what they can do.&lt;br&gt;• A little elf encourages user to overcome the threshold of the mind and summon a balloon which will take patient fly across the river.</td>
<td><img src="image4.png" alt="Image" /></td>
<td><strong>The virtual consultants and other virtual characters around the user's avatar make user feel like immersed in the socializing process.</strong>&lt;br&gt;<strong>Use Unity AIT to realize simple intelligent chatbot.</strong>&lt;br&gt;<strong>People who have the same situation with user can bring user a sense of connectedness and rapport.</strong></td>
</tr>
<tr>
<td>Quest</td>
<td>Psychologi cal Health Care Center</td>
<td>• View resources in the form of e-books.&lt;br&gt;• Gain experiences from sharing stories of people.&lt;br&gt;• Mental relaxation (e.g. Play video, Music therapy).&lt;br&gt;• Provide mental health course.&lt;br&gt;• Virtual psychological counselling and conversational interaction.</td>
<td><img src="image5.png" alt="Image" /></td>
<td><strong>The division of the scene and refreshing environment here bring users feel of spiritual growth.</strong>&lt;br&gt;<strong>A sense of regaining self-efficiency and control over their fate.</strong></td>
</tr>
<tr>
<td>Awakening and Growth</td>
<td>The Looking Up of Happiness</td>
<td>• Help user make positive changes in how they think and feel.&lt;br&gt;• Point to emergency hotlines and supporting resources.&lt;br&gt;• Schedule management and print off summary progress.</td>
<td><img src="image6.png" alt="Image" /></td>
<td><strong>The virtual consultants and other virtual characters around the user's avatar make user feel like immersed in the socializing process.</strong>&lt;br&gt;<strong>Use Unity AIT to realize simple intelligent chatbot.</strong>&lt;br&gt;<strong>People who have the same situation with user can bring user a sense of connectedness and rapport.</strong></td>
</tr>
</tbody>
</table>

*Table 2. The main functions of 3D virtual psychological self-service platform*
3.3 Design Considerations

Based on empowerment theory and above analysis, we expect that virtual world technologies when appropriately applied to the psychological self-service domain, can create a more attractive atmosphere and realistic scenario for users. The virtual consultants and other virtual characters around the user's avatar make user feel highly immersed in the social setting with a better sense of support from experts and peers. Moreover, a rich set of system-user interactions and personalized elements are integrated into this system to enhance the personalization of VPS. For example, intelligent virtual advisor with automatic actions and facial expressions in “Psychological Health Care Center” can communicate with the user. Whenever a user reaches a certain scene, there would be warm prompts which tell user what they can do, and encourage them to move forward step by step according to the road of spiritual growth. For instance, in the "Broken Bridge of Mind" scene, when users nearby the broken bridge lay across the deep blue river, they will see a little elf in the broken bridge which will encourage them overcome the threshold of the mind. Then the little elf will summon a balloon which will take patient across the broken bridge to fly across the river. These interactions can enhance the user’s self-efficacy and bring them sense of social presence and connectedness.

For another example, in “Sharing Room” within the “Psychological Health Care Center”, user can communicate with people who had the same similar experiences or situations with him or her. The shared stories of how they walked out of predicament and pursue happiness by people who once suffered from psychological conflict caused by different reason may bring users sense of support and enhance social presence from another perspective.

This system also has the potential to empower health consumers through giving them enough opportunities to make decisions and choices on their own. Users can easily customize their images in the system, gain control over many available resources, participate in all kinds of mental self-help activities to control their own destiny and influence the decisions that affect their life. The division of the scenes provide users with a more realistic goal within each division. It helps with generating a sense of closeness between their activities and achievements for the users. Throughout the self-help processes, users can feel their spiritual growth through process of lost, explore, quest, awakening and growth in the 3D virtual environments established in the VPS platform. This design idea is to get people to feel like regaining sense of control after some effort. With these gradual improvements, eventually they would be empowered to feel in control of their own fortune. These experiences are also expected to help users to establish more self-efficacy in dealing with challenging tasks and situations in real life in the future.

4 CONCLUSION AND FUTURE WORK

This study is the first stage of an on-going project. Based on comprehensive review of existing systems and design theories related to psychological self-help systems in literature, we constructed a three-dimensional virtual psychological self-service platform with multiple languages using 3DS Max and Unity3D tools. Currently in the piloting stage, the platform we constructed is expected to meet demands of people in high-stress occupations and people who wish to know more about effective ways to reduce pressure. Compared with ordinary 2D psychological self-service systems, our VPS platform is expected to enhance the user's social presence and sense of control in a more novel and interactive way. In addition, this system can be easily adapted and deployed on a variety of platforms, including iOS, Android, Windows and other platforms which allow users to access the self-help services whenever and wherever possible.

Besides remedying the insufficiencies of prior systems in design, our study aims at filling the gap in literature on the design theories for 3D virtual psychological self-service systems. We reviewed why virtual world is a better tool to help people in their mental issues compared with other medium and what the important aspects are in the VPS system design that impact on its effect for people. In sum, applying virtual world technologies to psychological self-service domain should be advocated as a way to provide timely support for people in high-stress occupations.

In subsequent stages of the project, we plan to enhance our system functionalities, especially for the design of our artificial intelligence chatbot in handling a variety of questions by the user. Through
continuous iterations of VPS platform design, development, evaluation and refinement, we will dig further into the important aspects of the VPS system design that are important for delivering its value for users, in order to contribute to design science knowledge. We also plan to conduct experiments with potential system users such as finance managers, medical practitioners or police officers. Through exploring the usage behaviour of people from different backgrounds, we can establish a more comprehensive understanding of the effects of this 3D VPS platform on people in high-stress occupations. Further, we will assign different groups to use different forms of VSP to explore different design strategies especially in regards to the empowerment outcomes of virtual advisory messages. We plan to measure the physiological data and the perceptions of participants through multi-method approaches involving interviews, questionnaires, as well as biofeedback from eye-trackers and heart rate monitors. While the system is specifically designed for people in high-stress occupations, future work could consider adapting the system into other contexts and establishing self-help service platforms for a variety of targeted groups.

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