Repeatable Experimental Framework for Wellness Indicator Testing/Evaluation: Environmental Setup

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***Abstract*—This paper presents more detailed information relative to an experimental framework for evaluating a wellness visualization system, mainly focuses on setting up an appropriate environment for conducting a testing session. Relative issues and considerations, e.g., selecting a testing location, suggested list of equipments and survey tools, and privacy issues, are also discussed.**

Keywords-testing methodology; system testing; wellness visualization system; information visualization.

I. INTRODUCTION

An agent-based wellness visualization system was presented in the previous publications [1-3] as a proof of concept of personal wellness indicator that is designed to assist a person to monitor, learn, and therefore promote their state of well-being; plus, providing decision support information to a caregiver with an alternative communication channel between a patient and a caregiver. The wellness indicator is constructed in accordance with the concept of the operational wellness model, as described in [2]. In order to verify and confirm the validity of the agent-based wellness visualization system, a repeatable framework for evaluating a wellness visualization system was developed. Two sets of questionnaires and evaluation metrics have been constructed from this framework. The wellness indicator will be evaluated by following the protocols described in the framework. Detailed information relative to the framework for testing a wellness visualization system can be found in [3].

The protocols, sets of questionnaires, and evaluation metrics are not enough for pursuing an effective measurement. There are other factors that can support and lead us to a well-performed testing session with high possibility of success; for example, location, equipments, number of volunteers per staffs per one testing session, etc. In this paper, we discuss the issues and solutions relative to setting up an appropriate environment for testing a wellness visualization system.

The paper is organized as follows. Next section gives background information relative to the operational wellness model and agent-based wellness visualization system. Section III provides the summary of the testing framework. The issues relative to setting up a testing environment are discussed in Section IV. Conclusions and future work are provided in the last section of the paper.

II. BACKGROUND INFORMATION

This section provides summarized information relative to the operational wellness model and agent-based wellness visualization system. More information is available in [1-3].

A. Operational Wellness Model

The operational wellness model is a wellness model that is created for an automatic measuring system and it is also a fundamental for developing our wellness indicator [2]. The model includes the operational definition of wellness and operational wellness evaluation model [2].

In this research, the term *wellness* is defined as "*a state of achieving best possible state of physical health and lifestyle within a person's capability*" [2]. Each person can have personal sets of wellness indicators; and each indicator has a certain target value or range [2]. A person might not be able reach the highest level of wellness but still can achieve their desirable level of wellness; in which case we consider them as being well [2]. A person having disability can be considered as being well (in certain areas), if they can manage to achieve the targets/goals of their wellness indicators. The visualization system supports monitoring of three sets of parameters, mainly focused on physical health, and to their improvement towards the target values/ranges [2]. The three sets of parameters are as follows:

1. Case-based indicator: initial sets of clinical objective parameters that are relative to certain cases. These parameters are predefined and provided to the end-users to choose. [2]

2. User defined indicator: a set of indicators defined by a user. The user can define personal indicators with target values or target ranges by following certain instructions and rules. [2]

3. Healthcare-professional defined indicator: a set of indicators defined for a patient by caregivers. [2]

A person can have a personal set of indicators for monitoring their personal wellness level and can expand/modify it as need. Thus, the operational wellness model is flexible, customizable and expandable.

The operational wellness evaluation model is

 ISBN: 978-1-61208-179-3

constructed based on the operational definition of wellness. Both single indicator wellness and overall wellness level are measured [2]. Single indicator wellness indicates the wellness level as perceived through a single indicator [2]. The results from a series of case-based indicators and healthcare-professional defined indicators are combined to become the overall wellness level of a person [2]. The latest results can be compared with the previous evaluations to find the progress and trend.

B. Agent-Based Wellness Indicator

The agent-based wellness indicator is an information visualization system and a physician/patient support system that employs the benefits of the information provided by existing electronics resources such as personal health monitoring devices and e-Health services [1-3]. The visualization system supports a person to enhance their knowledge relative to personal state of well-being and encourages the user to improve their wellness level [1-3]. The wellness indicator also assists a caregiver to gain access to a patient's wellness and analyzed information, including utilizing decision supporting tools provided by the system [1-3]. The wellness indicator employed the results from both types of wellness evaluation to visualize the state of wellbeing of a person in simple graphical formats [2].

A user can access to the system through personal computers, small form factors, and, in the future, televisions. The content presented on all types of devices is the same but on different layouts; mainly because of the screen size and the limitation of those devices.

The wellness indicator has various screens designed for supporting the two types of users who have different backgrounds and requirements [1]. A general user can access both regular and advanced modes [1]. The advanced mode allows a general user to view how their information is presented to the authorized caregivers [1]. A healthcare professional user has advanced screens only because these are specifically designed for supporting caregivers' tasks and the information provided in this mode covers the content in the regular mode.

For more detailed information of the agent-based wellness indicator, please refer to [1-3].

III. TESTING FRAMEWORK

Standard and de facto methods for measuring a wellness visualization system are not available at the time of writing. Therefore, a testing framework for evaluating a wellness visualization system is created to support the need [3]. The following information gives a brief summary of the testing framework.

The framework is created by following the Goal-Question-Metric approach [3-5]. The framework covers benchmarking in term of software quality, usability, and user's impression [3]. A wellness visualization system is measure in seven major aspects: system verification, system validation, verification of system's functionalities, validation of system's functionalities, usability of the GUI and graphical presentations, accessibility, and impression [3]. In other words, technical requirements, user's impression, feeling, and satisfaction are all measured. Both technical-oriented and user-oriented tools/methods are employed in this framework [3]. Examples of the employed testing tools/methods are questionnaires, comparative methods, and peer review [3].

We have created two sets of questionnaires and evaluation metrics from the framework [3]. Both questionnaires contain a combination of scale, forced choices, and open-end questions; a series of tasks; and instructions. The questions are formed in regard to the testing goals [3]. Each testing goal is created from the research's goal [3]. The questionnaires will be employed to collect information from both general and healthcare professional users. The collected data and the evaluation metrics will be used for measuring the agent-based wellness indicator.

IV. SETTING UP A TESTING ENVIRONMENT

As mentioned earlier, there are other issues and factors that we need to take into consideration to conduct an effective testing session. The followings are the important issues that we have encountered in our preparation phase of the testing process.

A. Selecting a Testing Location

It is important to select an appropriate testing location because good location allows a testing session to go smoothly and supports all relevant activities when conducting a study. It would be best if the location can represent where people normally do tasks and has no or, at least, minimum distraction. Therefore, some difficulties and problems caused by a real-life situation can be easily identified.

When selecting a testing location, one of the most important questions is "what do we need?". A list of tasks and activities, required equipments, survey tools, and supporting things must be created. Then, we can compare the list with the facilities and functionalities provided by each potential location. In addition, the following issues should be taken into consideration: volunteers, budget, accessibility, and timeline.

During a testing session, a user will be asked to follow a series of tasks, explore the wellness indicator, and answer the given questions [3]. A user can access to the GUI of the agent-based wellness indicator through both personal computer and small form factor [1-3]. Thus, the location must have enough space for at least one personal computer, one mobile device, one volunteer, one staff, a set of table and chairs, computer network connection tools/accessories, and survey tools. A space for a staff to make observation is also required.

Since there are two groups of volunteers, i.e., general and healthcare professional users, there might be special requirements from each of the groups. For both groups, we have to ensure the availability of the selected location matches with the schedule of our volunteers and can be accessed by all of them. In case of the general users, the user

 ISBN: 978-1-61208-179-3

can be a healthy, unhealthy, older, or disable person. Thus, accessible location is preferred.

For the healthcare professional user, asking them to leave their daily routine to participate in the study could be difficult because of their work and schedule. The testing location should be close, easy to access for this type of users, in order not to interfere with their tasks. It might be a good idea to make the testing site be able to relocate when it is necessary.

Moreover, we need to ensure that the location is in a private area. It should not be easy to access by an outsider. The private area can isolate the testing session from an unwanted distraction and unauthorized person. It also ensures the volunteers that we do respect their privacy.

In case of this research, testing session will be conducted in the University of Regina's area. One of the reasons is that the university provides an easy access to the locals and others; including people with special needs. The university is a place designed for studying, meeting, and performing an experiment and research; thus, it offers a good environment, i.e., appropriate lighting levels, well equipped rooms, privacy supported area, internet connection, parking area, etc. The university is also close to major hospitals and clinics. However, in case that the chosen location is not convenient for a participant, performing a test at the user's site is possible if permission is granted.

B. *Equipments and Survey Tools*

The followings are the major equipments and survey tools that are needed for this study and can be adopted by other research in the same area:

- Scripts and consent forms
- Researcher's contact information or business card
- Questionnaires
- The prototype
- Personal computer and/or laptop
- Mobile device
- Cables and extension cords
- Router or network hub
- Audio recorder with relevant accessories
- Video recorder with relevant accessories
- Secured data storage
- Stationary, e.g., pen, paper, and clip board
- Stop watch
- Compensation for volunteers, if provided

Providing some refreshments is also a good idea as they help people feel refreshing and comfortable, and sometimes can relieve frustration. Thus, the volunteers and staffs trend to be more comfortable and cooperative during a testing session; which leads us to an effective testing session.

When conducting a test at the user's site, there might be more stuff that we need to take with us and some arrangements are also required. A useful list, plan, and tips for taking a test at user's site can be found in [7].

C. *No. of volunteers vs. no. of staffs per one testing session*

Since we have limited number of observers, we have to limit the number of volunteers per one testing session for effective results. Krug suggested that the ideal number of participants in a usability testing session is three people or not more than four people because it guarantees that there will be more rounds of testing; which gives a possibility in detecting more problems [6]. In addition, a researcher will spend less time to process the collected data after each testing session [6].

The authors of [7] also indicate that research found four to five participants is an effective number. However, they feel uncomfortable with small group of participants. Therefore, they suggest at least eight people per testing session instead. The authors also recommend balancing requirements with the practical constraints relative to time and resources [7].

We agree with Krug's idea about having multiple rounds of testing sessions will reveal more problems and it is easier to control the flow and make an observation with smaller number of participants. However, it is quite difficult to follow when we have some limitations. Thus, we combine Krug's suggestion with the criteria given in [7].

When taking budget; availability of our volunteers, resources, and staffs; and research timeline into consideration, it turns out that when the number of rounds of testing sessions increases, the more money, resources, and time are needed. Adding the number of rounds also gives an opportunity for a volunteer to select the best available date and time within limitation, since the availability of the selected location and staffs are also counted.

Another important factor is the timeline of a research. When adding more rounds of evaluation, the total length of time to be spent on the testing process will be longer; this could affect a research's timeline or extend the finish line of a research.

In conclusion, multiple rounds of testing will be conduct and the number of volunteers in one testing session should be closest to Krug's suggested number while respecting the availability of the budget, volunteers, resources, and staffs; and the research's timeline.

D. *Data Collection and Protection*

Since we decided to perform one testing session with a group of volunteers and staffs, it is important to determine on how to collect the data while respecting the privacy of an individual; including how to protect those collected information.

In case of our team, it is wise to set up policies and explain them clearly along with the ethics considerations and protocols to the team members beforehand. It must be clear who have/don't have an authorization to access to the data, how to collect the data, how to keep the data safely, and how to protect the data from an unauthorized person. For example, a person who collects volunteer's contact

 ISBN: 978-1-61208-179-3

information must not copy, reveal, and distribute the information for both personal usage and any reason that is not related to the research. The volunteer's identification and personal information must be separated from their answers.

Moreover, there should be enough distance among volunteers during a testing session. Thus, peeking and unauthorized recording will be difficult to be done. In addition, there should be some spaces between each volunteer and an observer as well. Not only to respect their privacy but also create a comfortable atmosphere during a testing session.

All form of collected data must be kept in secured places. For hard copies, a locked cabinet or safe is preferred. In case of digital records, they must be password protected, encrypted, and must not be able to access through an unsecured connection.

E. Other Consideration and Limitations

The following are the issues and limitations that we have not encountered at the time of writing but they could affect the testing process of a wellness visualization system.

1) Testing environment management: performing a rehearsal is recommended as to review all relevant procedures and activities, and complete the checklist [6-7]. This includes making an agreement on the responsibility of each staff, verifying that they understand all steps and accept the policies, and confirming their availability. During a rehearsal, it is important to identify all the problems that we might face during a real testing session and what we have missed during the planning phase. Then, find the solutions to those problems before moving to the further steps. Performing more than one round of rehearsal is also an advantage.

2) Time management: time is a limitation that can be overcome by effective management and utilization. Timing all rounds of rehearsal is recommended. Both volunteers and staffs have their own schedule. If we have an approximate testing duration, it is easier to create a testing schedule and to make an appointment with both volunteers and staffs. Moreover, we have to ensure that we spend the testing time wisely by getting information as much as possible within a shortest period of time. One of the possible solutions is to prepare a list of interview questions along with the scripts and bring them on the testing day [6-7].

3) The prototypes: the prototype is tested in the laboratory isolated from outside connection during and after the implementation process by the researchers. However, it is possible that the prototype will not work properly on the testing day due to unexpected problems such as hardware problems and human errors. Thus, performing a rehearsal and having a backup on the testing day is a must.

4) Ethics and other privacy related issues: it is important to have permission before audio taping and video recording. When conducting an orientation, other than explaining about the research and the testing process, we should clarify what we are going to do with the collected data and records and how do we secure them before presenting a consent form. Also, all relative risks must be explained. Moreover, each volunteer has their right to opt out from the testing process anytime without any obligation. The data received from the withdrawn person must be destroyed immediately.

V. CONCLUSIONS AND FUTURE WORK

Currently, our research is at the stage of applying for a research ethics approval from the University of Regina's ethics board. While we are waiting for the results, we are concurrently preparing for the evaluation process as to start the testing sessions right after receiving the approval.

This paper gives people, who are preparing or conducting an evaluation for a wellness visualization system, some ideas relative to setting up a testing environment and relevant issues from our experiences. We wish that the information provided in this paper can give an insight to those who work in the same area and people who are interested in this research.

ACKNOWLEDGMENT

We would like to thank Thailand's Office of Educational Affairs and Telecommunication Research and Laboratories (TRLabs), Regina for giving financial support to this research.

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 ISBN: 978-1-61208-179-3