Simulated RN | Virtual Healthcare Agent

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YouTube Example of Prototype: http://youtu.be/wbVoZjJKaxw

Strategy

The Simulated RN project will utilize a virtual healthcare agent that is designed to deliver face-to-face consultation with patients while upholding a natural appeal. The main design goal was to improve the discharge process by providing an interactive learning environment that enriches user tasks through communicative commonality (e.g., reduced communication barriers). It is predicted that reducing barriers in communication during the discharge instruction process will subsequently improve the acquisition of knowledge, patient comprehension and satisfaction. Corresponding to the *Threshold Model of Social Influence* human beings initially only respond socially to other human beings (Blascovich, 2002; Blascovich et al., 2002). According to the Ethopoeia concept, if the design space includes social cues, such as interactivity, natural speech, or the filling of social roles, natural feelings are triggered and intrinsic social behaviors are performed (Putten, Kramer, Gratch, & Kang, 2010).

The interface is designed to automate and initiate conversation with the patient (user) and the testing of this process had to be modeled in a representative prototype in order to realistically evaluate the user's social reactions to the virtual social cues. It was believed that a low fidelity prototype would not be valid since many of the design characteristics are based on the virtual agent's communication abilities (verbal and nonverbal).

In addition, concerns with literacy levels for some patients, and addressing the needs of the hearing-impaired, the interface had to support audio narration with written subtitles to accommodate some users (Johnson, Sandford, & Tyndall, 2003). Furthermore, multisensory functions were needed to accommodate various user learning styles (Johnson, Sandford, & Tyndall, 2003), including subject matter content supported by visual aids (Koonce, Giuse, & Storrow, 2011). The presence of these elements in the prototype maximizes the usability and emphasizes the reliability and validity of the testing environment.

Two major driving forces behind the prototype strategy centered on the psychological aspects related to high agency and high behavioral realism. A high fidelity approach to prototyping was adopted to support both aspects in the prototype design. The *Threshold Model of Social Influence* suggests that a user will intuitively respond socially to another human or in a virtual reality environment to a high agency character (Putten, Kramer, Gratch, & Kang, 2010; Blascovich, 2002; Blascovich et al., 2002). Therefore, efforts were concentrated on the breadth of functionality by developing a prototype that represented characteristics that would model features in a potential target design.

A preliminary version of the system was prepared with (2) main aims:

1. A high degree of functionality
2. Consistency with interaction

Description of Prototype

The system features a limited 3D animated virtual healthcare agent that provides audio narration, capable of supporting multiple languages, in a touch based interface.

The system begins with an introductory sequence, followed by instructions on how to use the prototype, including an evaluation of the user's readiness or ability to understanding the navigation process.

The prototype of the system was designed with these main features:

- 3D animated virtual healthcare agent
- Computer generated speech, including a demonstration in Spanish (SIDS section)
- Subtitles
- Scripted conversation intended to communicated workflow, including instructions
- Touch based user responses, using modal dialogue boxes
- Ability to pause workflow at anytime
- Educational content related to post-partum discharge instructions:
    - proper feeding of the infant,
    - urination patterns, bowel movements,
    - umbilical cord care, skin care,
    - genital care,
    - signs of illness,
    - prevention of sudden infant death syndrome,
    - car seat selection
    - vaccine information
- Optional instructional video (*only a placeholder*)

Task Scenarios Table

The Simulated RN will simulate a discharge instruction process to accommodate a diverse array of primary and secondary user needs. In a Gestalt like manner, the configuration of system tasks is designed to support a unified whole process and not just the needs of a particular user group. The arrangement of prototype task components is derived from the analysis of all stakeholders.

All user tasks are initiated by the virtual healthcare agent, requiring the user to provide a touch based response in a modal dialogue box. The prototype is designed to wait for a period of time (e.g., Task 1: 2-minutes; Tasks 2 & 3: 5-minutes) and if no response is received by the system, the virtual agent will initiate a waiting for response cue. For usability testing, all responses are stored in a database, including the time required to respond as usability metrics.

	Task Description	Related Requirements	Usability Performance Metrics
Task 1	The user will be given instructions by the virtual healthcare agent outlining the intended workflow, including how to provide user input and navigation. The first task is to determine whether the user understands the basic instructions by answering the question—Are you ready to begin? User Task: Allow users to navigate the interface when they are prepared, or to locate desired information.	Communication, intended workflow, natural speech, simplified navigation, touch-based user inputs	Count frequency related to failure to make a selection. Count frequency related to the accuracy of a selection (e.g., correct or incorrect intention of selection). Time required selecting (in seconds). All of the tasks require touch-based user input or responses.
Task 2	Educational content will load and the virtual healthcare agent will provide additional instructions and teaching material. The Simulated RN shall monitor user preferences. The system can provide information related to user interest making the experience patient-centric. The second task is designed to determine a user's preference for feeding the infant (e.g., breastfeeding, formula feeding). The user's selection will be stored and subsequent educational content will correspond to this selection. For example, bowel movements correlate with feeding preferences. If a user selects formula feeding, the bowel movement section will emphasize information related to the previous selection (patient-centric). User Task: Offer various instructional opportunities for the user to explore.	Instructional framework	
Task 3	The virtual healthcare agent will provide additional instructions, education and multimedia content. The third task is another user preference. The Simulated RN will ask the question, "Would you like to an education video related to feeding baby?" The user will select either yes or no. The interface shall provide educational content to accommodate user learning styles, visual aids and preference. User Task: Accommodate the users learning styles by providing them learning options.	Instructional framework, multisensory, accommodate various user learning styles, visual aids	

Independent user navigation is allowed to explore the various educational content tabs, but the virtual healthcare agent will not respond to these user inputs. Therefore, the user may review any topic of

interest and periodically, the virtual agent will initiate a re-alignment of the educational content to verbal subject matter.

System Tasks Not Supported

The main system features not supported in the prototype:

1. A higher degree of behavioral realism, which takes more to develop.
2. A higher degree of clarity in the computer generated speech

User Tasks Not Supported

The main user tasks not supported in the prototype:

1. The user's ability to independently navigate to specific learning content where the virtual agent responds to their selection.

   The ability to adjust the instructional framework to adapt to a users comprehension framework to support the variance in health literacy skills.

Wish List of Features Not Supported

The main system features not supported in the prototype, but would like to have:

1. The ability for the interface to detect faces and therefore, initiate an automatic greeting response, "May I help you?"
2. The ability to recognize voice commands and natural language user inputs.

Reflection

"Oh, if I only knew then, what I know now."

The prototyping process is a great way to learn. I'm a trial and error learner, my preference is to learn by doing; more application, less theory. However, I learned a great deal through this process about the importance of upfront planning, data collection and other design techniques I underestimated in the past. Getting a good understanding of user tasks and system requirements increases the accuracy of system development, because the design is focused on their needs. Many of the approaches provided

insight into potential problems before reaching the prototype phase. For example, I found the use of flowcharting to be essential in understanding the structure and course of the conceptual design. I'm a visually oriented person, and I like the big picture perspective it provided. The flowcharting allowed for iterative designs to be created and adjusted until worked out in advance of a final plan. In addition to allowing me to anticipate potential strengths and weakness at different points, it kept me organized.

Also, it's a good thing to ask various people to review the prototype throughout the iterative design process. In the early stages of the prototype design, the virtual agent had blues eyes, which were the default color of the character. When I would informally demonstrate the conceptual prototype idea to others, everyone would remark, "her eyes look creepy." It never occurred to me that there was something wrong with the eye color. However, it occurred so often without me prompting people for advice on that particular feature that I had to make a change. After the change, no one mentioned the eye color.

There is a saying, I'm not sure where it comes from, but it states, "You cannot improve what you can't or don't measure." The psychological perception related to eye color may not have come out in the usability testing, if I didn't specify an opportunity to measure this component. As a result, I realized that formal testing has a specific purpose, but informal feedback can be equally as important to design acceptance, especially when dealing with perception. I still have plenty to learn in regards to measurement and quantitative methods, but I did realize how important informal feedback can be.

The exploration of functionality in prototyping provided an opportunity to enhance capabilities, and fix flaws, before moving too far ahead in development. By detecting potential problems in the prototype design, I can see where it reduces the potential for error later on when it matters.

References

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