Robotics 204: Introduction to Human-Robot Systems
Winter 2025

Lab Title: Usability Study Design

Submission Type: Team Submission

Learning Objectives:

1. Design and implement a usability study to assess a system.
2. Evaluate usability study outcomes to inform system design iterations.

Introduction:

As mentioned in class, a system must be **Useful** in that it accomplishes what is required; it must be **Usable** such that the task can be performed easily without danger of error; and it must be **Used**, where people want to engage with your system. Usability testing allows designers and researchers to identify problems in the design concept, discover opportunities to improve the system, and to learn more about the types of users. In this lab, you will design a usability study for evaluating your system ***that will be conducted in an upcoming lab.***

While some usability studies have a physical system to test, usability testing can occur much earlier. Receiving feedback on sketches and diagrams *before* creating a system saves significant time and money. The study will be split into four phases: a demographics survey, a training phase, a usability task phase, and a post-task phase. The demographics phase is where you collect information about your user that can help you contextualize your findings and understand your user. The training phase is your opportunity to describe and teach the user what they need to know about the system before they use it. The usability task phase is when you will have the user interact with your system ***without providing any guidance***. Lastly, the post-task phase is an opportunity to again engage with the user and obtain additional feedback on the system that can be used to support your design iterations.

Lab Procedures:

Part 1: Formalizing the usability study tasks

Usability study tasks are selected to be representative activities that the user would perform. Defining and explaining your study task consistently is important because it can influence how the user interacts with your system. The term study task is specific to the actions the user will perform during the usability study. Based on the stage of design, the study task may be different from the use-case task when the system is a physical prototype. Since your system will be conceptual diagrams, care should be taken to define study tasks that can be performed at this stage. We will use a think-aloud method for testing, where you provide the study task prompt and the nurse narrates their responses of what they would do. The benefits of the think-aloud method is that with the running monologue, you can learn misconceptions a user may have, why they take a specific action, and the ordering of the steps they take. *When you find misinterpretations or incorrect sequences, those are opportunities to update your design to support understanding.*

1. You previously created storyboards to define how the user would interact with your design concept. They may have been very specific or quite broad with assumed embedded sub-tasks. From your storyboards, consider the study tasks that you could assess with concept sketches. Select 3 tasks you feel would support your design iterations at this prototyping stage of development. Justify why you selected these specific tasks. The tasks should support your team assessing usability. In Part 2, you will provide details on your usability concepts. However, you should consider what usability concepts you want to assess to support the selection of your tasks. In completing Parts 1 and 2, you may find it helpful to iterate on your tasks, questions, and selected usability concepts. These parts depend on each other and iteration is encouraged.

2. With these study tasks, define questions that users could reasonably expect to answer at the current stage of design. Consider very specific questions, such as "how would you turn on the system?" as well as more broad questions such as "you need to perform <action> to support your patient, how would you perform this task knowing <your system> is available?" Create a list of questions for each task that will support the nurse to think-out-loud about their interactions with your design concept.

3. The study tasks that you have selected may need additional sketches and diagrams beyond your initial ideation sketches to support the user understanding the task. Create diagrams of your conceptual design to support your usability evaluation.

4. It is likely your user will need training before they are even asked questions about the study-tasks as you are designing a new system. What training information will you need to provide? You will want general diagrams so that the capabilities of your system are clear, but there might be specific elements that need more description. Remember, during the usability task phase, you cannot help the user or comment on how they use the system, even if they make errors. It is important for determining user understanding to have the researcher remain quiet during this phase. Create the training diagrams and instructions that will be used prior to the usability task phase.

Part 2. Selecting the usability concepts to evaluate

In this section, your team will define what usability concepts will be evaluated and will select attributes to operationalize these concepts. There were several concepts discussed in class that are important for usability analysis. Each of these concepts can be operationalized to support design decisions. The tasks you select will also inform the attributes that are reasonable for your assessment.

Recall the usability concept is the most abstract, the dimension provides more context, and the attribute is what you will measure. There are no fixed ways that are always used to measure usability. As designers, we need to determine what dimensions (what definitions of the concept) are relevant for our particular system. There are guiding principles on how to define these concepts, but they need to be

formalized for a particular system and setting based on the goals of using the system and the requirements we are trying to meet. The concepts are how we think about usability from different perspectives. A dimension is just a way to interpret the larger concept. For example, the dimensions of learnability would be how you define what it means to learn the system. A dimension of learnability could be (1) First-use learnability (e.g., how well you use the system the first time you try it), or (2) Shape of the learning curve (e.g., slope, or linear/non-linear behaviors), or (3) Time until proficiency (e.g., how long until they achieve a certain level of performance in time or repetitions). Each of these dimensions leads to different attributes that you would measure. The attribute is just what you are measuring. So for the dimension of First-Use Learnability, the attribute could be how many attempts it took to successfully complete the task. We could also consider First-Use Learnability as the time it took to perform the task on their first attempt. These are each attributes associated with the first use of the system, which is a dimension of the concept learnability.

However, not all usability attributes are appropriate for all phases of the design process. For a conceptual design, the time to complete the task is not well-aligned as you will not have the physical prototype and study task set-up to make this measurement. As you consider relevant concepts, dimensions, and attributes, you should assess whether they are appropriate for what you can measure in your usability test during the upcoming lab.

1. Select two usability concepts. Provide two attributes that you would like to measure for each concept. For each attribute selected, state the dimension it aligns with (i.e., the definition of the concept being used) and the level of measurement associated with your operationalization.

2. How are the attributes you selected related to the study tasks you selected in Part 1? Justify your selection of attributes in context with your tasks. What would be reasonable goals for your system for each attribute? What is acceptable for performance at this stage and what would lead to needing design changes?

Part 3. Preparing for the user study

You now have an idea for your study tasks, the training and diagrams that may be needed, and the attributes you will assess. Now you need to bring these ideas together to create the testing procedure for your study and the materials you will need for the study. Your testing procedure provides the steps that are taken in your study.

1. Create the list of demographics questions you would want to collect and justify why the selected questions are relevant. (For example, you should consider collecting years of experience as a nurse.)

2. Put together the training information that will be needed for the nurses prior to you asking them to perform the usability tasks.

3. Create the diagrams that will be needed to support your usability tasks.

4. At the end of a usability task phase, you also have the opportunity to obtain open-ended feedback. What additional questions would you want to ask the nurses to obtain their feedback on your design?

5. Write out the complete usability testing procedure, inclusive of the demographics questions, training phase, usability study task phase, and post-task phase. You should target **20 minutes** as the maximum time necessary for one person to complete your usability study. Make sure to list the steps for what you will tell the nurses and what you will ask them to think-aloud. It is important to consider what you say to the nurses at what point during the testing as you can bias the users if not careful.

Part 4. Practicing the usability test procedure

Prior to running a usability test with the relevant user group, it is important to test your protocol within your team. We learned during our human-centered design module that teams may include a community collaborator. These community collaborators are important in many of the design stages, including developing the usability tests. While we do not have a nurse on your design team, you can still obtain feedback from your peers, the GSI, and the IAs.

1. Partner up with another team in your section or the IA/GSI present in your section and practice running through your protocol. Focus on practicing the training phase and usability task phase. Was it clear to the other team what you were asking? If not, make updates to your training and questions as needed.

Deliverables:

The following should be included in your submission.

1. For Part 1, provide your selected tasks, questions to consider, additional sketches/diagrams, and training approach.
2. For Part 2, provide the details of the usability attributes selected.
3. For Part 3, provide the complete usability testing procedure document with any updates based on practicing the procedures.
4. For Part 4, summarize updates that were made to Part 3 based on your practice in lab.