MIMBCD-UI
User Testing Guide

Francisco Maria Calisto
francisco.calisto@tecnico.ulisboa.pt

09/04/2018

Prototype: prototype-breast-cancer
Version: v1.0.6-alpha
Milestone: 1.0.6-alpha
Release: v1.0.6-alpha

DICOM: dicom-server
Commit: d889ba07d715a3f47bc01634f2163af30b147a20

Deployment Environment: Test
Deployment Server: Test
Link: breastscreening.isr.tecnico.ulisboa.pt

Main Server: Test
Port: 8081
Private IP: 10.0.1.23
Public IP: 193.136.138.62
Private Domain: cromo.isrnet

DICOM Server: Test
Port: 8043
Private IP: 10.0.1.23
Public IP: 193.136.138.62
Private Domain: cromo.isrnet
From: 8143

1 Introduction

This document aims to describe the protocol performing a set of tests in the scope of v1.0.6-alpha version from the prototype-breast-cancer repository of the Medical Imaging Multimodality of Breast Cancer Diagnosis User Interface (MIMBCD-UI) project using a traditional devices (mouse and keyboard). The goal of the test is to understand the user, performance, efficiency and efficacy metrics. With the session, the sessions will be recorded via video on the computer and using a record, heat-map and triggered event tools. It is guaranteed the confidentiality of the recordings, which will be used only for academic purposes.

Dividing the activity session into three distinct phases of the three tasks. In all three tasks, by supporting our traditional devices, the interaction with mouse and keyboard. The first phase is the act of doing those tasks. On the second phase, we will do a small questionnaire at the end of each task using NASA-TLX [2]. Finally, the third phase we will have a final survey regarding the Usability of the system. The well-known scale called System Usability Scale (SUS) [1].

2 Material

For the material and apparatus, it is essential to capture the session apprehending the user interactions. In our case, we will record this interaction by using the QuickTime Player Version 10.4 (928.5.1) to obtain all interactions. We will pair this video tool with a user watch tool called Hotjar. This tool serves the purpose of using several logs of the interaction and gives us visualisation over it. Both instruments will help us to capture where are users interacting. By looking at the test participant's reactions, we find a lot of information regarding the prototype design.

The tools that we choose for the material and apparatus of this User Testing Guide are low-cost and easy to use. Our equipment is a cost-effective and, by using our laboratory materials, bringing it to the radiology room, we enable to capture not only what the user is doing on the screen, but on the body language supported by the interviews and observation.

The material used in the test sessions for the user interface consists of:

- MacBook Pro: it will allow the user to interact with the keyboard and a wireless mouse;
- Wireless Mouse: it will allow the user to interact with a mouse and will complement the keyboard;

2.1 Technical Details

To produce this traditional environment, and since we can simulate with a laptop, the mouse and keyboard interaction, we are using a Microsoft Mobile Mouse 4000 together with the MacBook Pro (Retina, 13-inch, Early 2015) with a standard integrated keyboard on the laptop.

2.2 Software

To track our user interactions across our system, we are using Hotjar. This tool is an analytic package allowing us to follow our users remotely. It also provides two critical pieces of functionality, among others, that can aid in remote user testing. First of all, the heatmaps allow us to see where users are clicking, tapping and scrolling on our system. Second, it records a video playback of the entire user session. The tool shows evidence of being useful for our studies while we successfully used it in the past.

To record the task activities and the interview, we used QuickTime [3]. The QuickTime (Apple Computer) tool is available for MacBook Pro to movie, audio and screen recording. Despite of have an overall of features, we just used it for our user's screen recording. It provides this functionalities at minimum requirements and compatible to our apparatus.

3 Description

To verify our work, we identified measurable and explicit targets. By having several goals, including that a value percentage of the users should be able to operate the tasks without the need of help. On the same rate value, the user should be able to start and complete the medical diagnosis tasks over the system with little errors or mitigating those errors. Measuring the expected number of errors with a relation between our laboratory pilot tests. On the laboratory pilot tests we aim to test our prototypes with Researchers. The Researchers are in the context of the system and know well the functionalities so that we need to expect a percentage value over their results compared to Clinicians and not the same benefits. Last but now least, both users (Researchers and Clinicians) should be able to understand in a similar time amount the meaning of all visible controls. By the similar amount of time, it is expected to have a variance of the percentage value between Researchers and Clinicians of the same value percentage of the early goals described in this paragraph.

We tested each objective in early laboratory and field tests so that we could take the appropriate corrective actions. Also, we expect to run early field tests with Researchers and Clinicians to highlight issues that we overlooked and ignored during the prototyping phase. To support interaction use by the Clinicians, we will try to emphasise several key factors on our user tests. The tasks must be simple, low intrusive, support for natural interaction and the system must always give visibility and the task current-state.

3.1 Devices

Traditional interaction remains the most common way to interact with user interfaces in a clinical environment. Unfortunately, most of this interaction is made by low profile equipment that makes users produce more errors and take more time interacting with those user interfaces.

On Figure 1 the user can select the list of patients. The list has a table with several patient information. The first column is the *Patient ID*; we used it as an identifier of the patient. That way we can have anonymised information with no reference to the patient name. The second column is the *Study Date*, the third column is the *Modality* of the used **DICOM** image, the fourth column is the *Study Description* of the used study and the last column is the number of *Images*.

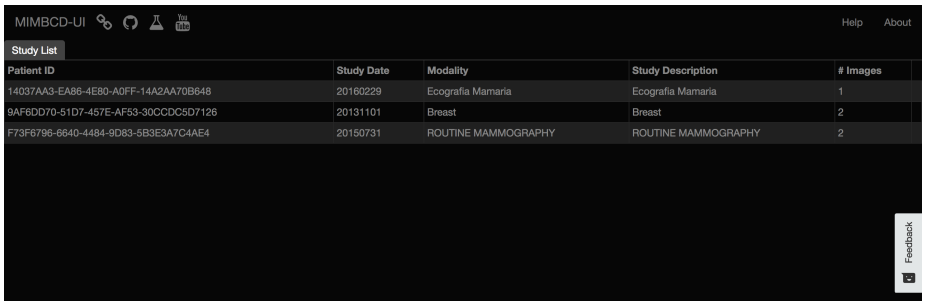

Figure 1: List of patients.

As we can see in Figure 2, it shows the first task in our User Interface (UI), where the patien's breasts are on a small left column. The options are in a short row near of the viewport and described below. We also have the tabs where the user can change the patient. The centre viewport shows the **DICOM** image, and it can be configured to display a number up to four **DICOM** images. The viewport has some text information on it (yellow) with the details of the metadata.

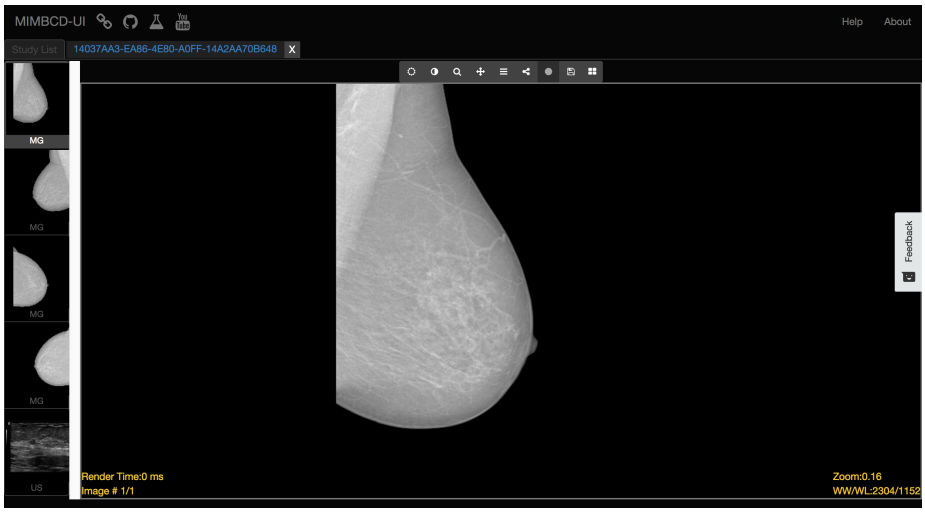

Figure 2: Viewer of the **DICOM** images.

Manual annotation is adopted by us thanks to Freehand ROI and Probe annotation features, both from CornerstoneJS. According to the CornerstoneJS Library, the user can create an annotation by setting up consecutive landmarks around a Region of Interest (ROI). The markers finish a lesion annotation when it interconnects the historical. Additional features available in our User Interface (UI) includes on-demand increment of the number of landmarks, and throw transformations of the shape of an annotation.

3.2 User Interaction

The systems have several buttons (Figure 3) that allows the user to interact or access to a set of user interface features. Each item of the following list represents each metaphoric icon of Figure 3.

Figure 3: Toolbar of the System available features.

The buttons are (from left to right of Figure 3) as follows:

- WW/WC
- Invert
- Zoom
- Pan
- Stack Scroll
- Freehand
- Probe (Deactivated)
- Save
- Window Controller

3.3 Usability Evaluation Technique

Number	Issues of Content Key Questions
1	How do you perceive this activity?
2	Could it be done in a more intuitive way?
3	What are the consequences?
4	Why did you do as you did with this activity?
5	Is this activity relevant for you?
6	Could you suggest another way to do this activity?

Table 1: My caption

4 System

Lorem ipsum dolor sit amet, consectetur adipiscing elit, sed do eiusmod tempor incididunt ut labore et dolore magna aliqua. Ut enim ad minim veniam, quis nostrud exercitation ullamco laboris nisi ut aliquip ex ea commodo consequat. Duis aute irure dolor in reprehenderit in voluptate velit esse cillum dolore eu fugiat nulla pariatur. Excepteur sint occaecat cupidatat non proident, sunt in culpa qui officia deserunt mollit anim id est laborum.

4.1 Environments

Lorem ipsum dolor sit amet, consectetur adipiscing elit, sed do eiusmod tempor incididunt ut labore et dolore magna aliqua. Ut enim ad minim veniam, quis nostrud exercitation ullamco laboris nisi ut aliquip ex ea commodo consequat. Duis aute irure dolor in reprehenderit in voluptate velit esse cillum dolore eu fugiat nulla pariatur. Excepteur sint occaecat cupidatat non proident, sunt in culpa qui officia deserunt mollit anim id est laborum.

Nisi ut aliquid ex ea commodi consequatur? Vel illum qui dolorem eum fugiat quo voluptas nulla pariatur?

4.2 Interaction

Lorem ipsum dolor sit amet, consectetur adipiscing elit, sed do eiusmod tempor incididunt ut labore et dolore magna aliqua. Ut enim ad minim veniam, quis nostrud exercitation ullamco laboris nisi ut aliquip ex ea commodo consequat. Duis aute irure dolor in reprehenderit in voluptate velit esse cillum dolore eu fugiat nulla pariatur. Excepteur sint occaecat cupidatat non proident, sunt in culpa qui officia deserunt mollit anim id est laborum.

List of something with no enumeration:

- Something 1
- Something 2
- Something 3
- Something 4
- Something 5
- Something 6
- Something 7

- Something 8
- Something 9

Lorem ipsum dolor sit amet, consectetur adipiscing elit, sed do eiusmod tempor incididunt ut labore et dolore magna aliqua. Ut enim ad minim veniam, quis nostrud exercitation ullamco laboris nisi ut aliquip ex ea commodo consequat. Duis aute irure dolor in reprehenderit in voluptate velit esse cillum dolore eu fugiat nulla pariatur.

5 Procedures

Lorem ipsum dolor sit amet, consectetur adipiscing elit, sed do eiusmod tempor incididunt ut labore et dolore magna aliqua. Ut enim ad minim veniam, quis nostrud exercitation ullamco laboris nisi ut aliquip ex ea commodo consequat. Duis aute irure dolor in reprehenderit in voluptate velit esse cillum dolore eu fugiat nulla pariatur. Excepteur sint occaecat cupidatat non proident, sunt in culpa qui officia deserunt mollit anim id est laborum.

5.1 Initial Questionnaire

Lorem ipsum dolor sit amet, consectetur adipiscing elit, sed do eiusmod tempor incididunt ut labore et dolore magna aliqua. Ut enim ad minim veniam, quis nostrud exercitation ullamco laboris nisi ut aliquip ex ea commodo consequat. Duis aute irure dolor in reprehenderit in voluptate velit esse cillum dolore eu fugiat nulla pariatur. Excepteur sint occaecat cupidatat non proident, sunt in culpa qui officia deserunt mollit anim id est laborum.

- Sex, Age, Literacy.
- Experience with ...
- Experience with ...
- Experience with ...

5.2 Introduction

Lorem ipsum dolor sit amet, consectetur adipiscing elit, sed do eiusmod tempor incididunt ut labore et dolore magna aliqua. Ut enim ad minim veniam, quis nostrud exercitation ullamco laboris nisi ut aliquip ex ea commodo consequat. Duis aute irure dolor in reprehenderit in voluptate velit esse cillum dolore eu fugiat nulla pariatur. Excepteur sint occaecat cupidatat non proident, sunt in culpa qui officia deserunt mollit anim id est laborum.

5.3 Training Session

Lorem ipsum dolor sit amet, consectetur adipiscing elit, sed do eiusmod tempor incididunt ut labore et dolore magna aliqua. Ut enim ad minim veniam, quis nostrud exercitation ullamco laboris nisi ut aliquip ex ea commodo consequat. Duis aute irure dolor in reprehenderit in voluptate velit esse cillum dolore eu fugiat nulla pariatur. Excepteur sint occaecat cupidatat non proident, sunt in culpa qui officia deserunt mollit anim id est laborum.

5.4 Execution of Tasks

Lorem ipsum dolor sit amet, consectetur adipiscing elit, sed do eiusmod tempor incididunt ut labore et dolore magna aliqua. Ut enim ad minim veniam, quis nostrud exercitation ullamco laboris nisi ut aliquip ex ea commodo consequat. Duis aute irure dolor in reprehenderit in voluptate velit esse cillum dolore eu fugiat nulla pariatur. Excepteur sint occaecat cupidatat non proident, sunt in culpa qui officia deserunt mollit anim id est laborum.

5.5 Final Survey

Lorem ipsum dolor sit amet, consectetur adipiscing elit, sed do eiusmod tempor incididunt ut labore et dolore magna aliqua. Ut enim ad minim veniam, quis nostrud exercitation ullamco laboris nisi ut aliquip ex ea commodo consequat. Duis aute irure dolor in reprehenderit in voluptate velit esse cillum dolore eu fugiat nulla pariatur. Excepteur sint occaecat cupidatat non proident, sunt in culpa qui officia deserunt mollit anim id est laborum.

6 Tasks

During our usability tests, we need to ask participants to provide a subjective assessment of their experience using our system. There are several widely used questionnaires giving us different prons-and-cons. However, in most cases, a single question instrument [4] is the right method for a quantitative usability testing. By taking less time and effort to answer, participants are pursuing to this phase after task while it is minimally disruptive.

In our **User Testing Guide** a set of tasks is necessary and carefully crafted. Our usability studies involve asking participants to perform the following tasks. By looking at what our user need to do with our system, our tasks are realistic as possible. We are not describing the exact steps participants need to take. We achieve that by avoiding the precise language used as labels in our system. The tasks are emotionally neutrals. And we did several pilot tests to prevent misleading situations saving us from wasting resources by accidentally use a lousy task or from getting bad data. The tasks are as follows.

List of stand alone tasks:

Task 1: Annotate the **US** modality from the **20160229** date;

Task 2: Annotate the last but one medical image of the **Breast** study description;

Task 3: Annotate the second **MR** frame number **10** of the last patient;

7 Measurements

Lorem ipsum dolor sit amet, consectetur adipiscing elit, sed do eiusmod tempor incididunt ut labore et dolore magna aliqua. Ut enim ad minim veniam, quis nostrud exercitation ullamco laboris nisi ut aliquip ex ea commodo consequat. Duis aute irure dolor in reprehenderit in voluptate velit esse cillum dolore eu fugiat nulla pariatur. Excepteur sint occaecat cupidatat non proident, sunt in culpa qui officia deserunt mollit anim id est laborum.

- Measurement 1;
- Measurement 2;
- Measurement 3;
- Measurement 4;
- Measurement 5;
- Measurement 6;
- Measurement 7;
- Measurement 8;
- Measurement 9;

Lorem ipsum dolor sit amet, consectetur adipiscing elit, sed do eiusmod tempor incididunt ut labore et dolore magna aliqua. Ut enim ad minim veniam, quis nostrud exercitation ullamco laboris nisi ut aliquip ex ea commodo consequat. Duis aute irure dolor in reprehenderit in voluptate velit esse cillum dolore eu fugiat nulla pariatur. Excepteur sint occaecat cupidatat non proident, sunt in culpa qui officia deserunt mollit anim id est laborum.

- Difficulty of ...
- Difficulty of ...
- Difficulty of ...
- Degree of ...

References

[1] Konstantina Orfanou, Nikolaos Tselios, and Christos Katsanos. Perceived usability evaluation of learning management systems: Empirical evaluation of the system usability scale. *The International Review of Research in Open and Distributed Learning*, 16(2), 2015.

[2] Anjana Ramkumar, Pieter Jan Stappers, Wiro J Niessen, Sonja Adebahr, Tanja Schimek-Jasch, Ursula Nestle, and Yu Song. Using goms and nasa-tlx to evaluate human–computer interaction process in interactive segmentation. *International Journal of Human–Computer Interaction*, 33(2):123–134, 2017.

[3] Melissa R Rowell, Frank M Corl, Pamela T Johnson, and Elliot K Fishman. Internet-based dissemination of educational audiocasts: a primer in podcasting-how to do it. *American Journal of Roentgenology*, 186(6):1792–1796, 2006.

[4] J Sauro. 10 things to know about the single ease question (seq). *Measuring U, 2012*, 2012.