

NEIMO, a Multiworkstation Usability Lab for Observing and Analyzing Multimodal Interaction

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ABSTRACT

NEIMO is a generic and flexible multiworkstation usability lab that supports the observation and analysis of multimodal interaction as well as Wizard of Oz experiments. It captures behavioral data at multiple levels of abstraction from keystroke to high level tasks. In the near future, it will be used to study the relevance of multimodality for telecommunication tasks.

Keywords

Usability testing, usability lab, multimodal interaction, Wizard of Oz usability testing.

INTRODUCTION

The combined use of multiple interaction techniques such as speech and gesture opens a new world of experience. Although the potential for innovation is high, our current understanding about how to design and evaluate multimodal user interfaces is still primitive.

Current theoretical and heuristic frameworks for evaluating interactive systems do not cover multimodal interaction properly. At CLIPS-IMAG, we have developed NEIMO, a generic and flexible multiworkstation usability lab, to observe and analyze multimodal interaction experimentally [2]. This video shows NEIMO applied to a multiservice telecommunication terminal to elicit the usage of multimodality in the context of telecommunication tasks.

STRUCTURE OF A NEIMO EXPERIMENT

As shown in Figure 1, using the NEIMO platform involves a two-step process: the experimentation session followed by an analysis phase.

Phase 1: Experimentation session

In phase 1, a subject executes a set of scenarios on a dedicated workstation. In a different room, human factor experts observe the subject, make annotations, or simulate the missing functions of the system (e.g., speech recognition) using their own workstation.

Meanwhile, behavioral data about the subject as well as experimenters' annotations are recorded automatically. NEIMO captures information at various levels of abstraction from keystroke level such as mouse events and speech acts, to high level tasks such as sending a fax.

In its current version, the NEIMO platform includes 4 Apple Macintosh Quadras connected by Ethernet. The user interfaces for the subject and the wizards workstations are prototyped with HyperCard. Apple Events are used as the standard communication mechanism but a specific tool has been developed for efficient transmission of video over Ethernet. (Sound is not yet transferred over the network.) Behavioral data are recorded using the QuickTime format.

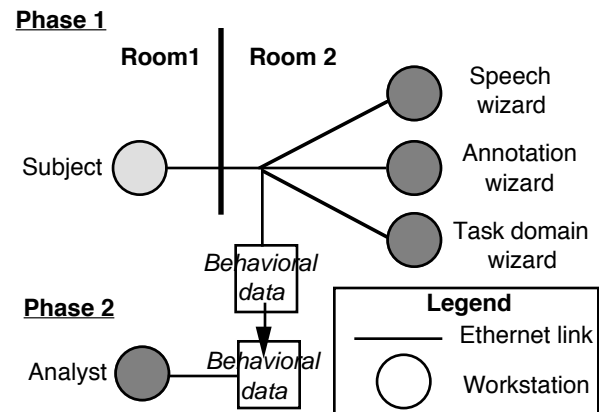


Figure 1. Configuration of the NEIMO platform.

Phase 2: Analysis of Behavioral Data

In phase 2, behavioral data are used by specialists to assess the usability of the system. In the context of our research, the motivation is to elicit the usage of modalities according to our CARE framework [1]: Complementarity (i.e., combined use of multiple modalities as in the "put that there" paradigm), Assignment (i.e., systematic use of a particular modality), Redundancy (i.e., simultaneous use of multiple modalities with identical semantic content as in uttering "Call Jo Smith" while clicking Jo's direct phone number), and Equivalence (i.e., multiple modalities used alternatively to reach a given goal).

AN EXAMPLE OF EXPERIMENTATION

In the task scenario shown in the video, the subject calls Daniel using speech and direct manipulation in a complementary way as in "Call this person" while clicking Daniel's name in the directory.

The speech-wizard translates the multimodal command into actions understandable by the system. To accomplish this, he can hear the subject talking and a miniature reproduction of the subject's screen allows the speech-wizard to track the user's mouse and keyboard actions.

If the subject makes a linguistic mistake such as uttering a wrong command name, the speech-wizard sends an error message through a dedicated tool. As shown in Figure 2, error messages are predefined and organized into categories (lexical&syntactic and domain-dependent errors), or may be customized on the fly. In the normal case, the speech-wizard simulates the subject's actions using direct manipulation on the miniature screen which, in this example, triggers a phone call at the task-wizard's.

The task-wizard, who plays the called person, incites the subject to use advanced features such as the Vphone and mirror facilities of the multiservice terminal. The subject hesitates. The annotation-wizard who can observe the subject's behavior through his own workstation (sound+ miniature screen), records a comment about the subject's hesitation. This information, which complements the subject's wrong mouse clicks, will be pointed out by the analysis tool in the next phase.



Figure 2. The screen of the speech-wizard: on the left, a miniature of the subject's screen; on the right, the error messages tool (enlarged artificially for the purpose of readability).

THE ANALYSIS TOOL

In its current form, the analysis tool provides quantitative data such as the duration of scenarios as well as statistical information through the facilities provided by a spreadsheet program. It does not yet support editing facilities nor the rendering of multimodal usage. It does however replay the set of scenarios (just like a VCR) and provides browsing facilities such as rewinding the "VCR to the previous lexical error".

In addition, the tool makes tasks interleaving explicit using a Gantt diagram laid out on a perspective wall. The diagram is enhanced with clickable "bubbles" that reveal the annotations recorded on the fly by the annotation-wizard.

NEIMO'S KEY FEATURES AND THE STATE OF THE ART

Most usability labs are not computer-supported. NEIMO, which is able to *digitally record behavior* at various levels of abstraction, opens the way to the development of

automated analysis tools that alleviate the time-consuming manual analysis of a large body of data such as repetitive pattern of behavior.

In addition to observation and annotation, NEIMO supports Wizard of Oz experiments. Most existing Wizard of Oz systems support the observation of one modality only or are limited by technical constraints. NEIMO has been designed from scratch to support *multimodality*. A significant amount of effort has been dedicated to implementation issues to satisfy performance requirements.

NEIMO is *multiworkstation, generic and flexible*: 1) It supports any number of wizards; 2) It is organized around a reusable and extensible kernel of common services onto which specific user interfaces can be plugged; 3) Workstations are configurable at start up time: wizards roles (e.g., speech recognition, annotations, etc.) can be freely allocated among the workstations. In addition, data capture can be set up at the appropriate level of abstraction.

PERSPECTIVES

In the near future, we will conduct full-fledged experiments to study the relevance of multimodality for telecommunication tasks (preliminary results for drawing tasks show that in deictic expressions, pointing is often performed first [4]). We also need to find the balance between digital and analog recording in order to conciliate precision, volume of recorded data, and potentiality for automatic evaluation. Having primarily developed NEIMO for capturing behavior, we need now to augment our analysis tool with new computation and visualization facilities.

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