

Towards an Interactive and Iterative Process to Design Natural Interaction Techniques

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Abstract. With the rise of different interaction modalities, several different devices are available to users that need to learn how to interact with them. To avoid problems in the future, developers need to create intuitive interaction techniques, which is not a trivial task. To support the design of these techniques, we present a process where users interactively and iteratively participate in the design, through a series of individual interviews and focus groups. We also present two case studies, for a multimodal and a multi-touch application.

Keywords: Natural Interaction, Multimodal and Multi-touch applications.

1 Introduction

As envisioned in the 90's [12][15], today computers are present all around our daily environment and a person can own and interact with several of them during the day. This increased use and the different contexts in which computers can be found, requires more natural types of interaction [1][12][13], like touch, gestures and speech.

The interaction with these natural modalities needs to be studied to generate the best interface design principles. There are several characteristics that must be addressed to provide the best design or these natural interfaces may suffer from bad decisions [9]. It is important to generate gestures, like body or motion device gestures, that are socially acceptable [10]. It is also important to define gestures that are intuitive to use, or users may forget how to execute them [6].

A solution to overcome possible design problems is to execute user studies before implementing the system. As stated by [8], this approach can lead to gestures that are easy to perform, easy to remember, intuitive, iconically logical towards functionality and more ergonomic. Morris et al [7] compared surface gestures created by users and researchers, and concluded that participants preferred gestures created by large groups of people, such as those created by end-users or proposed by more than one researcher.

Moreover, there are other works that propose user studies to generate natural gestures for different systems [4][8][11][14][16]. This work presents an enhanced approach to extract the interaction with the system using user studies before implementation.

This work present a process focused on the final implementation, introducing a focus group phase to improve the interaction of the initial interviews. The process description and examples of its application are presented in the next sections.

2 Proposed Process

The process definition focuses on the generation of the input interaction with the system, although it also exposes ideas for output. Therefore we use the term interaction¹ from this point on in the paper to focus on the input, unless explicitly stated. Next sections present the five phases of the process.

2.1 Definition of the System

For the first phase of the process we start with an initial set of commands based on the defined purpose of the intended system, or we could execute a user study to explore and understand the use of the system and generate its initial commands, as used by Henze et al [4].

2.2 Individual Interviews

We recommend a semi-structured interview process, using a qualitative approach [2] with a restricted number of users (5 to 10), in order to deepen the discussion. The interview allows us to extract possible interaction techniques and capture participants' opinions and ideas. Here we are concerned about presenting the user a general vision of the system, and immersing them in its context of use.

We propose the following steps to conduct the interview: (I) Introduction: Introduce and present the research goal and sign the consent form; (II) Participant profile: question the user about his/her experience with technologies that share common characteristics to those that will be used by the system; (III) Interaction Proposals: present the idea of the reference system to the user and for each command that the system will provide ask them to propose the best way to perform it using some modality (according to the system being studied).

2.3 Interview Analysis

Based on the results of step III, the researcher should generate an initial set of interaction techniques. For each command, the users' proposals can be categorized by similarity. Since the focus of the process is on the implementation of a specific system, we recommend that the categorization also be done based on the limitations of the referenced system technology. For instance, a free-hand gesture recognizer may not be able to perceive individual fingers, but only the whole hand. If a gesture proposal was made with the movement of the finger in the air, and another participant made a similar movement using the whole hand, these two proposals could be categorized into only one category. However, we should validate in the next phase, the Focus Group, the system's known limitations that may affect the proposed gestures' implementation.

¹ In this work we use the terms interaction and interaction techniques in the same sense: the way users interact with a system.

The frequency of proposals for each category can be filtered and only a subset of all gestures proposed in the interviews may be used for the next phase.

2.4 Focus Group

The next phase is to use a focus group to validate, reduce, expand or enhance (or a combination of these) the set of interaction techniques proposed in the interviews. This study method was used in other HCI research [3][5], and can reveal feelings and beliefs that benefit from discussion in a social setting. We recommend the number of 3 to 10 users in the group, as suggested in the literature [3][5].

We suggest the following steps for the group meeting: (I) Research introduction: Introduce and present the research goal to the participants and sign the consent forms; (II) Participant profiles: Questions about the participants' profile and their experience with similar technologies; (III) Present the system: Introduce to the participants to the system's concept; (IV) Interaction Discussion: For each command the system has, we should (a) Explain the command to the participants, (b) Present the participants with the selected interaction ideas generated from the individual interviews. (c) Validate them and ask for better alternatives if they are not accepted by most of the participants, (d) Ask participants about further details of the interaction for possible implementation, taking into consideration the known limitation aspects of the technology.

The researcher should encourage the discussion about the participants' opinions in order to build a general understanding of what they want the system to be. In this phase, as generally executed for focus groups [3][5], more than one group could be used to have different possible groups opinions and user profiles. As additional part of the focus group, a prototype or a similar system could be shown to the users, so they can better understand possible uses, ideas and provide feedback.

2.5 Converging Interaction Definition

The interpretation of the focus group results should be related to the improvement of the initial set of interactions proposed by the individual interviews. If participants from the focus group do not approve a gesture that was previously chosen as one of the most suggested (from the interview phase), the gesture should not be promptly discarded and replaced by a new and not similar suggestion from the participants. It's interesting to question the participants about the reasons they do not like it. New suggestions that are more consistent with the scenario may be used in place of others, but this evaluation needs to be based on the designer's interpretation.

3 Case Studies

We executed two case studies, following the proposed process. The first, focusing on interaction techniques for a multimodal presentation system (including interaction through smartphone, body and hand gestures, and speech), and the second one a visualization information tool, with data manipulation by selection and zoom commands through multi-touch devices (exploiting the use of multiple fingers).

In the first study – multimodal system - nine participants were recruited using a convenience sampling for the interview process. Five of them were female. All nine

participants were students in computer science programs. The age of the participants ranged from 19 to 32. In the second study – visualization information tool - we conducted seven interviews with undergraduate and graduate students from different areas, such as law, economics and computer science. All of them were also recruited by convenience sampling and they were between 20 and 33 years old.

In both cases, the Interviews phases allowed us to gather several interaction possibilities for each system, which were consolidated in the Focus Group phases. The most preferred interaction actions for each command were chosen and then presented to the groups, with the purpose of validating and reducing the initial set of interaction. In the multimodal system case study, two focus groups were conducted. The first group was composed of a convenience sample of eight undergraduate students in computer science programs, ages ranging from 17 to 20. The second group was composed of six undergraduate students in computer science programs, ranging in age from 19 to 26. In the visualization information tool case study, only one focus group was conducted with six participants and they were between 18 and 32 years old. The group was made up of undergraduate and postgraduate students from economics and computer science areas, also recruited by convenience sampling.

The main difference of the proposed process - the use of focus groups - made it possible to discuss the ideas suggested by the participants and to find the best ways to interact with the focused systems based on the opinions of several users. The focus group was a good source of ideas and reflection on interaction for real use. In the first case study, for instance, a big concern was how the use of the system could be affected by the context (for example if the presenter is moving or speaking a lot, a non-desired command cannot be recognized and activate the system); in this case the use of two groups gave an interesting diversity to the research, some commands were generally accepted as they were, or only slightly modified, whereas others had different outcomes for each group. Without the focus group, could be a hard task to decide the gestures/movements to implement. In the second case study, for example, the designer could opt for more elaborate gestures but users chose simple gestures with a few fingers.

4 Final Considerations

We proposed a new process that aims to involve users in the elaboration of interaction techniques through the use of individual interviews and focus groups. The process provides us with a quick and simple way of obtaining the users' interaction preferences. The main difference between our process and related work is that it relies on the addition of an additional phase where, after initial interaction derivation from individual interviews, we use a focus group research for further evaluation, interaction detailing, and to resolve possible conflicts that may arise. As a method carried out before the final development, it reduces the possibility of having rework in implementation and also allows for adjustments or further evaluation.

The results of the case studies carried out show us that the process could help the designers to understand users' preferences and difficulties in the use of some techniques. This can help them to generate the interaction techniques needed for the applications they are developing. Future steps in this proposed process should be applied research in other case studies, especially dealing with distinct modalities, to help us to refine and improve it.

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