Making Handheld Computers Effective and Usable

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Abstract

Today, there is a wide disparity among owners of handheld computing devices in terms of rates of satisfaction. While some users rate their devices as an invaluable prize possession, others say they are a promising, but become a waste of time and money. The current challenge for software designers of handheld computing devices is differentiating between the valued usable systems and the non-productive pointless systems. The quest for quality, effectiveness, and usability focuses on the improvement of the ingredient that impacts the user the most, the interface.

The interaction between users and their handheld devices will be significantly improved when a design method called user-centered design is used to create the interface. The user-centered design methodology involves the true users to validate, evaluate, and verify the entire interface (all device inputs and displays) during multiple developmental milestones.[2] A powerful resource in this endeavor of interface development is the usability evaluation lab (ULAB).

This paper presents the challenges in the design of an effective and usable handheld computer system. An introduction into usability issues is given with focus on successful dialogues between humans and the handheld device. An approach for user-centered design and incorporation of a ULAB is outlined and explained. Finally, the procedure of securing quality in handheld computing systems with the use of the ULAB is outlined with the results from the last two years.

Introduction

Usability evaluation is an empirical study with true users of proposed systems providing feedback in iterative development cycles. It has come to be recognized as an integral part of quality assurance and its effect on quality can be readily measured. The field of software development has reflected increasing interest in usability evaluation, which is generally performed on new software and hardware in the development stages. The concept of usability evaluation is to enable user validation of all the system's requirements, assurance of successful interaction dialogue, and verification of effective work production. By ensuring the valid occurrence of these elements,

usability evaluation enhances product quality and customer satisfaction of the potential product.[3]

Typically, usability evaluation is performed by a typical user in a lab with a one-way observation mirror that allows the development and evaluation team to observe what happens when the user attempt to use the handheld device system. Video cameras, computer programs, and interviews capture all relevant information for later analysis. However, the lab is essentially a data collection tool and will not enhance the evaluated system unless there is also an applicable method to correct any discovered usability defects. Historically, the last decade of testing labs still produced systems with glaring usability defects.[2] Southern Polytechnic State University (SPSU) has created a Usability Center to support the design of usable systems. The usability evaluation lab and specific methodology is part of the curriculum in the Computer Science, Software Engineering, and Information Technology degrees.

Quality in Handheld Computing

In the quest for quality, software developers are focusing on the improvement of the ingredient that impacts the user of a software system the most, the interface[1]. The interface will be significantly improved when a design method called user-centered design is used in the development of the software product. The user-centered design methodology includes the evaluation of the interface by typical users during multiple milestones of the lifecycle.[4] A powerful resource in this endeavor of interface development is the usability evaluation laboratory. A true user is given scenarios of common tasks to be done on the handheld device. The usability evaluation team observes and logs metrics from the interaction dialogue between user and the handheld device. A pre and post interview with the user explores their expectations and the satisfaction (or dissatisfaction) of their task completion in the scenarios. Defects found among the system's communication, recognition, jargon, and organization are studied for a solution that corrects the handheld system.

The School of Computing and Software Engineering at SPSU utilizes the usability evaluation lab as a two-part experience within the software engineering course and the user-centered design course. The main purpose for the ULAB in both courses is the provision and capability to ask users to evaluate the usability of systems. Usability is one of the main principles contained in user-centered design. User-centered design systematically approaches software design with the intent to fit the software to the genuine needs of users. It provides a scheme for quickly understanding users in relation to systems, their working intentions in carrying out tasks, and the support they need from the system to perform those tasks.[5] The ULAB, as a curricular resource, prepares our graduates to apply their knowledge to industry usability evaluations by promoting usability as an integral part of the software's pursuit of quality. Specific usability evaluation projects are done in the ULAB with the user-centered courses and software development courses. During the last two years, six user-centered design courses (SWE 4324) and three software engineering courses (SWE 4624) designed their team project as a dual PC and handheld application. The challenge of creating two usable systems that were targeted for different environments, the desktop and the handheld, was met with multiple design ideas. These ideas were implemented in prototypes that went through a complete usability evaluation.

The usability student team begins the usability evaluation by gathering information about the handheld system prototype to be evaluated. The main three deliverables (goals) in the gathering information step are (1) the task analysis, (2) the user analysis, and (3) the conceptual modeling of the interaction. The task analysis is the study and determination of the characteristics present with regards to the users of the handheld device. These characteristics include: previous knowledge needed, decision strategy, cognition loading, and other factors. The modeling of the interaction is illustrated in a clear diagram of input needed from the user to complete tasks with the handheld device. Interviews with the student designers of the handheld systems are conducted to obtain a description, purpose, and current development stage of the system. The active participation of both student designers and student usability evaluators in the team is critical to the success of the evaluation; conversations between these groups provide supportive confirmation of the progress in the design of the new software, and specific feedback to guide for changes to the next iteration of software's design. Research evidence shows how usability evaluations speed up many software projects and also produce dramatic cost savings.[8]

The usability evaluation is usually conducted in multiple days with one pilot evaluation session and four additional sessions. Five to six recruited users come for these sessions. Usability requirements are represented as performance measures which the team logs as events[1]. These events are usability metrics decided in the previous steps. A formula for the acceptance or the redesigning of each aspect of the handheld system is also determined. During the last portion of the evaluation, the student teams prepare the study findings and recommendations.

Currently, the complied evaluation results for two years of student projects have yielded the following guidelines for designing dual PC and handheld applications:

- Provide a common “look & feel” to both that is recognized by the user,
- Determine the list of work goals for the handheld usage and focus an interaction that mimics the PC, and
- Maximize the human’s ability to recognize patterns by representation of the PC’s elements in fuzzy content.

Usability Methodology

Many pitfalls and breakdowns lie on the path to building good interactive handheld computers for humans. Designers need to assimilate the breadth of knowledge necessary for designing real systems and focusing on the characteristic elements of human factors. The requirement analysis of a design project starts with the identification of the users and their related species. The lexical interactive perfect dialogue desired between the human user and the handheld system is based on the user's cognition model and all past similar experiences. Interviews and studies of the users can extract their cognition models and long-term memories. But these yield a heterogeneous group of preferences for the dialogue. So which model, memory, or experience should the dialogue resemble? Therein lies the challenge: the creation of one dialogue of interaction to accommodate all models, memories, and experiences.

Designers hope for a magical precise formula out of a design guidebook -- a list of principles that prescribe the correct design. However, interaction design is a problem solving activity that thrives

on experience, wisdom, and extensibility; there is no one correct guidebook. The above bullet list of suggestions learned from the previous two years of user centered design and software engineering coursework does not prescribe an omnipotent solution to the current PC and handheld project. The correctness of building a prototype of the system needs to encompass what matters, what makes sense and what the user can do.[7] Every designer problem solving decision that enables effective and usable software design must be presented to the user in a current usability evaluation to verify the current design.

Ubiquitous Computing

Currently the approach for future computing systems is a direction towards ubiquitous computing, where the computer component is invisible to the user. This equates to everyday common uses of complex systems reduced to abstract simple tasks, for instance, plugging an electric device or driving a car. In both, users are not expected to know how electric current enables the device nor how gasoline turns the tires of the car. Similarly, handheld devices' future focuses on the user's work production and not on the inner computing environmental workings.

The benefit of portability is accessibility anytime from anyplace. Work productivity is of course an important concern in terms of handheld devices in today's workforce. Users of the current anytime from anyplace devices are found to be less efficient in the accomplishment of tasks than desktop or laptop users. But the users perceive positive yield that outweighs the lower production. The trade-in of convenience access, mobility and work completion in otherwise non-productive environments is strong enough to warrant the acceptance of a reduced efficiency.[6]

The design of interfaces for the small displays of handheld devices merit careful design strategies. Specific recommendations were common in the SWE 4324 students' experiences:

- Careful selection of what to display
- Elimination of unnecessary information
- Minimization of clutter in order to create a simple display
- Organization of information in order to present a recognized structure
- Successful recognition from the user's perspective
- Emulation of the user's model
- Limitation of scrolling to one direction (horizontal or vertical)
- Facilitation of effective navigation
- Common work merits a common interaction mechanism
- Specific goals associated with retrieving from WWW should mimic the user's model of the task

The articles in Ratner's book also agree with the above list of recommendations for the design of the handheld display.[6]

Conclusions

The practices of true users validate, evaluate, and verify a proposed handheld system during design is critical for the effectiveness and usability of those systems. The user's performances and subjective reactions compared to the expected scenarios reveal the complexity and trade-off

needed in successful ventures. Not only problem area identification, but problem solving is important components of user evaluation. Future developers can maximize understanding of and adherence to the concept of user-centered, task-oriented systems and thereby develop superior hand-held devices. Through this evaluation experience, designers can gain and utilize wisdom of interface design which can then be extended into all future system development. This paper has presented an exposition, analysis, methodology, and results of the problem solving involved in the user-centered, task-oriented software development strategy for handheld systems.

Bibliography

1. Bailey, R.W. (1996) Human Performance Engineering. Using Human Factors to achieve Computer System Usability. Prentice Hall, Englewood Cliffs, New Jersey.

2. Constantine, L. L., L. A. D. Lockwood. (1999) Software For Use. Addison Wesley, Reading, Massachusetts.

3. Mayhew, D. (1999) The Usability Engineering Lifecycle. Morgan Kaufmann, San Francisco, California.

4. Nielsen, Jakob (1993) Usability Engineering, Academic Press, Boston.

5. Preece, J., Y. Rogers, H. Sharp, D. Benyon, S. Holland, and T. Carey. (1994) Human-Computer Interaction. Addison-Wesley, Reading, Massachusetts.

6. Ratner, Julie. (2003) Human Factors and Web Development. Lawrence Erlbaum Associates, Publishers, Mahwah, New Jersey.

7. Rosson, M. B., J. M. Carroll. (2002) Usability Engineering. Scenario-Based Development of Human-Computer Interaction. Morgan Kaufmann, San Francisco, California.

8. Shneiderman, B. (1998). Designing the User Interface. Strategies For Effective Human-Computer Interaction. Addison-Wesley, Reading, Massachusetts.

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Thomas is a full professor in the School of Computing and Software Engineering at Southern Polytechnic State University for the last seventeen years. The areas of Software Engineering, User-Centered Design and Computer Graphics & Multimedia are the focus endeavors. She is a co-founder of the SPSU Usability Research Lab and is directly involved in corporate-sponsor ULAB projects.