Interaction Design Concepts for a Mobile Personal Assistant

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ABSTRACT

The Personal Assistant for onLine Services (PALS) project aims to develop an intelligent interface that facilitates efficient user interaction through personalization and context awareness with commerce web sites on a handheld device. The types of assistance services and interaction support represented by a mobile personal assistant have been investigated in the PALS project. Scenario Based Design was used to develop the PALS framework for the personal assistance services, generic scenarios and a usage model. The service concepts (e.g. direct, solicited, non-solicited, independent) characterize interaction between the user and virtual assistant during mobile web tasks. The generic scenarios and usage model aid to develop design and interaction of the PALS interface. A theme of "personal customer support" through an attentive interactive display can aid user acceptance of mobile web task assistance.

Keywords

Personal assistance, Interaction design, mobile devices,

INTRODUCTION

Improvements in the wireless networks with 3G+ technology providing more bandwidth, security and reliability for cost effective data transfer along with wireless Internet access technology can improve a user's mobile device experience. However, users must still cope with constraints of mobile computing that include limited screen size, limited input capabilities (e.g. small keyboard, stylus input), constraints in physical environment (e.g. noisy location, awkward position of use), frequent disconnections and data loss [5]. The nature of mobile computing creates issues due to constraints of wireless technology (i.e. handheld device, network), mobile task characteristics, a fluid environment and various mobile services that design for a one size fits all website.

Users of handheld devices have unsatisfactory experiences due to the complexity of interaction with tasks, web service, device and mobile environment. For example, Tom is riding in a taxi and using a handheld to transfer money between bank accounts to purchase a new watch. While conducting the transaction he realizes that the taxi driver has passed his final destination. Tom informs the driver to drop him off at the next corner. Standing on the street he returns to complete the transaction, but has lost his place in the task and needs to cancel and start the transaction over.

The Personal Assistant for onLine Services (PALS) project aims to develop an intelligent mobile interface for quick and accurate task performance with mobile commerce web sites. A retail-shopping environment was chosen as a basic model for personal assistance, since in general people have had experiences with a personal form of retail service, such as customers often receive sales assistance from a store representative (e.g. sales assistant). Service is defined as work done by an assistant for a customer or end user. The retail service metaphor can be extracted to define types of services based on interactions between a user of a mobile device and the PALS virtual assistant within a mobile web usage context. PALS services and a usage model were conceptualized using a personal customer service metaphor based on a retail-shopping environment.

This paper introduces the PALS personal assistance concepts distinguishing user and virtual assistant interactions for an intelligent interface using a scenario based design method, and qualitative data analysis techniques, resulting in (a) PALS assistance services (b) PALS generic scenarios (c) a mobile personal assistant usage model and (d) translation of scenarios to design concepts.

In developing PALS intelligent interface concepts the following questions were posed: (a) How can scenario based design be used to develop a PALS framework? (b) What are the core assistance concepts that represent PALS?

SCENARIO BASED DESIGN METHOD

Scenario Based Design was used to create an early "top down" vision of the PALS intelligent interface [2]. SBD provides a cohesive method for extracting design ideas and obtaining data in the form of scenarios from project partners. A two-hour scenario workshop was conducted with a total of five project partners representing the financial, telecommunication, software industry and PALS usability design team members. The objective of the workshop was to provide a forum to collect scenarios describing how participants envision the usage of the PALS system by end users in a mobile context. The workshop consisted of an overview to the scenario based design process describing how scenarios function (e.g. a projection of a concrete description of a user activity during a task) and depiction of scenarios (e.g. avenues for presentation of usage interaction and offering a solution). Each participant was given two sample scenarios and a blank worksheet for describing setting, actors, goals and conditions to be included in the scenario. The participants were asked to provide scenarios of PALS usage in a mobile context. The group was given 45 minutes to develop free form scenarios describing usage of the PALS system.

Qualitative Data Analysis

Nine scenarios were analyzed using qualitative data analysis. A general form of qualitative analysis was applied for categorizing scenario data using open coding techniques. Open coding is an analytic process for identifying concepts discovered in text data [6]. The scenarios were first analyzed to identify concepts, which are abstract representations of interactions between a user of a handheld device and PALS system. First, the whole scenario was analyzed and then each sentence of the scenario was analyzed using coding notes to record generic PALS system use. Objects, which are actions and events pertaining to interaction between the user and virtual assistant, were coded based on types of interaction provided by the virtual personal assistant to the user (i.e. "the mobile assistant has to help her by finding the price of the house on different websites", "the assistant gives her good advice when she asks for it"). Objects were selected based on the following general criteria:

(1) The object describes general usage or intent to use PALS system, represents an interaction, tasks of user, user or PALS response, state of PALS system or user.

(2) The object can reflect one or more interactions.

Finally, the interactions were collapsed into larger categories of concepts. For example, the scenario text was coded and placed into four service categories.

Based on the scenario data, two generic scenarios were used as summary scenarios culminating general descriptions of user interactions with PALS in the financial and travel domains of interest. Key events were chosen from the generic scenarios in which several use cases were created to describe a specific service for interaction between PALS and a user. A use case was constructed for each service concept specifying the event, user description and actions, location description, type of device, and service type. The use cases described in more detail the initial PALS interaction design ideas integrated with the PALS services that were generated from the workshop scenarios. Based on this information a cohesive description of initial design ideas could be presented to the project design team. Finally, a usage model was iteratively developed with business and design team members providing concrete examples that incorporated a common PALS vision based on the scenario analysis. This scenario method drove design from a top down perspective providing concrete examples of the PALS vision to all members on the project.

PERSONAL ASSISTANCE CONCEPTS

Here we cover the PALS concepts derived from the scenario analysis and relate them to the initial framework of the PALS interface and interaction design. The results of the scenario analysis identified a theme of personal customer service, with the virtual assistant acting as an intermediary integrating the commerce sites and service of presenting the screen and task interaction for enhancing user web performance. The use of the PALS personalized intelligent interface was primarily integrated within a mobile usage context. Overall, there were three primary findings, which include types of PALS services provided to users, generic scenarios describing future use of the PALS system and a PALS usage model.

PALS Assistance Services

Personal customer service was a significant general concept throughout all scenarios. The user of the mobile device was represented as a customer and the virtual assistant as the store representative. To further refine PALS services and to draw relationships to real life user experiences a retail personal customer service metaphor was used to explore interactions that occur in the real world between a store representative and a customer. Interactions between a customer and a sales representative can be categorized on four levels. For example, a customer walks into a store and makes a *direct* request to find an item. The sales person sends the customer to a specific aisle. If the customer is unable to find a product, he/she can then *solicit* the representative for help in finding an item such as retrieving of shoes. *Unsolicited* services can also be presented to the customer where a sales clerk will ask "May I help you find something today" or an announcement on the store intercom informing on the sale item of the evening. Receiving flyers at a residence or bagging of groceries are services based on *independent actions* by the store representatives.

The interactions between the user and virtual assistant are described in four forms of service, which are directed, solicited, unsolicited and an independent service. The frequency of occurrence for objects within each type of

service are directed service 36%, solicited service 29%, non-solicited service 13%, independent service 22%.

The user and virtual assistant interactions were formalized into PALS assistance services. The type of service along with examples from the scenario data describes the type of assistance the user received. These service concepts provide a design foundation for PALS user interaction utilizing a familiar concept of "retail customer service" for a form of collaboration between the virtual assistant and user. This framework introduces a familiar user mental model that can support the user when interacting with PALS.

(1) Directed (D) "do what I say" service allows the user to submit requests immediately to the assistant (e.g. similar to a search engine request). For example, a user requests the assistant to provide a travel route not impeded by a current traffic jam [4].

(2) Solicited (S) or "can you help me?" service allows for the assistant to work with the user by request. For example, the personal agent guides the user through finding real estate prices on the web [4].

(3) Non-solicited (NS) "smart" services are automatically provided by the assistant on the handheld, which include personalized interface presentation and interaction services [4]. For example, instant messages are interceded by the assistant when received during a transaction or personalized attention guides are provided when returning to a web task to ensure quick and accurate performance during a task.

(4) Independent (I) services are "relevant" intelligent actions conducted by the assistant based on user profile information (e.g. "wake up calls by assistant on the basis of predicted travel time and connections," "informing a hotel of the customers arrival") [4].

PALS Generic Scenario
These generic scenario excerpts presents an example of a financial and travel scenario during use of PALS.

Hank is a busy professional ….by train he travels to a business meeting. He visits his Internet bank account with a handheld device to transfer money between accounts. The train is a little dark, noisy…PALS provide a screen display with attention cues and efficient navigation path to conduct tasks quickly and accurately (NS). While in the financial web site PALS intercepts all non-emergency Instant Messages informing the messenger to hold or try back later (NS). Account information is automatically saved and updated to the Internet account by PALS if there are lapses in service while the train is moving (NS).

Barbara is an active senior citizen…. Using a desktop computer she organizes a weekend trip. PALS presents the travel website with a screen view accommodating her vision (NS). She asks PALS to direct her within the site for destination specific hotel information (S) and decides on a

hotel. Late for an appointment, she provides PALS with dates and accommodation information requesting PALS to book hotel reservations (D). At her lunch appointment, she uses her handheld to show the accommodations to her friends, presented in a consistent fashion from the original desktop view (NS). PALS confirms the hotel reservation then provides her with a list of suggestions for further travel arrangements (IS).

PALS Usage Model
The PALS usage model (Figure 1) depicts the mobile usage context representing the user, task and environment with the PALS system providing assistance for user interaction with the handheld and use of web services. The virtual assistant is the intermediary integrating the commerce sites and service concepts for presenting the screen and task interaction to enhance user web task performance. In order to enhance user web task performance in a mobile context, the PALS system would also need to address solutions in the form of support concepts to aid users in conducting tasks during use of the web. As listed in the task interaction box for support concepts of interruption mediation, task attention indicators, adaptation of web interface see Nagata [4].
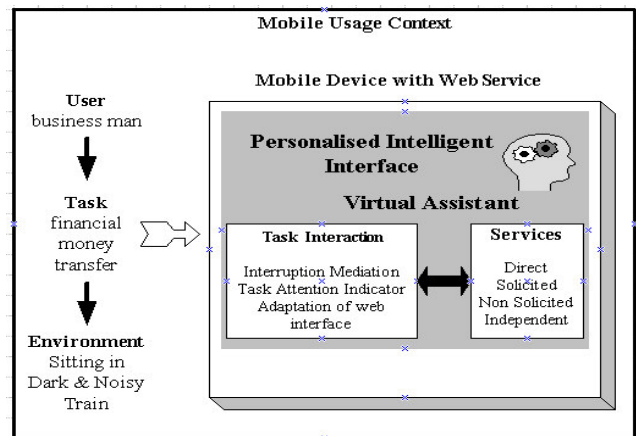

Figure 1. PALS Usage Model

A summary of user characteristics was captured from the workshop scenarios. User characteristics were described as: user demographics (e.g. age 16-65 years, occupation), cognition (e.g. memory, attention), intent of use (e.g. finance, household, domestic), user interests (e.g. music, travel), tasks (e.g. web transactions and information search, scheduling appointments), environment surrounding and location (i.e. train, office, home), and physical mode (i.e. sitting, walking). In addition, general lists of interaction qualities were also identified from the scenario data. The general PALS "look and feel" were summarized as the following: a non-intrusive assistant with minimal interaction giving direct or explicit advice or suggestions, pro-active with self initiated activities, predicts immediate needs of user, consistency in presentation with various devices, smart and informative interaction design concepts for the mobile context.

From Scenarios to Design Integration and Empirical Validation

This scenario based design work is the foundation for a user interaction framework and initial design concepts for the PALS system. The outcomes of the assistance services, generic scenarios and usage model communicated a summary of design ideas for the visual presentation of a PALS mediated mobile web interface, depicting of user and PALS communication interaction, and solutions related to support concepts that enhance user web performance.

The outcomes of the scenarios have influenced design development of the PALS system in several areas. We briefly present each area in the PALS project resulting from the scenario process. Firstly, initial user requirements have been defined based on the generic scenarios and translated into a PALS interface demonstrator; see Lindenberg, Nagata & Neerincx [3]. Secondly, the interaction and interface design ideas have been represented in storyboard form and have been qualitatively validated with users of handheld devices, see Brolman [1]. Lastly, research integrating support of web task interaction where the personal assistant adapts the interface to the user have been translated into web interaction designs and investigated with study participants, see Nagata [4].

CONCLUSION

In conclusion, PALS aim is to enhance user interaction with mobile devices and web services by facilitating quick and accurate web task performance using an intelligent interface. Scenario based design was used in a workshop with a multidisciplinary team to develop a cohesive "top down" vision of the PALS intelligent interface. Scenarios written by the team members were analyzed providing key ideas on potential user expectations of the system and support for a user mental model of "customer service" during usage by future end-users. The interface presents a virtual assistant as an intermediary supporting adaptive changes during user interaction.

The scenario based design method was used to generate a conceptual framework of the PALS system. The concepts of direct, solicited, non-solicited and independent services were derived along with generic scenarios and a usage model representing relationships linking the mobile context with the intelligent interface. The assistant services will support mobile task interaction through the use of support concepts (e.g. attentive interactive display) facilitating the user to complete a web task.

DISCUSSION

The results from the scenarios produce initial ideas on addressing our first question: How can scenario based design be used to develop a PALS framework? The process of scenario-based design focused the team to develop a collaborative and integrated interface concept with a focus on the user. This method aided to consolidate ideas and views of PALS and the representative concepts. The formation of concepts for the PALS framework highlighted the important theme of "personal customer service" representing a realistic model for users to comprehend the interactive exchange of information and services with the PALS system.

Secondly, what are the core assistance concepts that represent PALS? PALS will deal with mobile web task issues through a smart interface, enhancing user interaction through a personal assistant. The concepts for direct, solicited, non-solicited and independent services described levels of interactions between PALS and the user. The services are considered flexible and can be presented for different situations possibly overlapping or in combination. Refinement of the PALS services continues as the project progresses.

The service concepts, scenario and usage model guide development and research for the PALS system. Future research will focus on investigating interaction attributes with a specific focus on interruptions generated on the device (e.g. Instant Messaging, virtual assistant communication) and guiding users attention to improve user task performance.

REFERENCES

[1] Brolman, L. Requirements engineering – A method to gather PALS user requirements. Masters Thesis University of Twente, 2004, 45-58.

[2] Carroll, J.M. *Making Use Scenario-Based Design of Human-Computer Interactions.* Cambridge MIT Press, Boston, MASS, 2000.

[3] Lindenberg, J., Nagata, S.F. & Neerincx, M. Personal Assistant for onLine Services: Addressing Human Factors, Human Centered Computing, in *Proceedings of Human Computer Interaction International Conference 2003.* (Crete Greece, June 2003), Lawrence Erlbaum, Mahwah NJ, 497-501.

[4] Nagata, S.F. Multitasking and Interruptions During Mobile Web Tasks, in *Proceedings of the Human Factors and Ergonomics Society Annual Meeting 2003.* (Denver CO, October 2003), Mira Digital Publishing, St. Louis, MO, 1341-1345.

[5] Nagata, S.F., Neerincx, M, & van Oostendorp, H. Scenario based design: Concepts for mobile personal service environment, in *Adjunct Proceedings HCI International 2003* (Crete Greece, June 2003), Lawrence Erlbaum, Mahwah NJ, 11-12.

[6] Sadeh, N. *M-Commerce; Technologies, Services and Business Models.* Wiley, Boston, MASS, 2002.

[7] Strauss, A. and Corbin, J. *Basics of Qualitative Research 2nd ed.* Sage. Newbury Park, CA, 1998