

User-Participatory Idea Generation for Usability Testing of Information Appliances

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Abstract: Usability testing has increasingly become useful tool as products become complex and smart enough to support cognitive aspects of human being. Among various methods for usability testing, particularly, lab-based usability testing is one of the most widely implemented methods for its advantage of collection of rich data and user's direct involvement. In spite of its advantages, however, the method still has critical disadvantages such as high cost, time and effort, unnatural testing environment, and lack of user's direct participation to idea generation. With these backgrounds, this paper aims to develop the web-based tool for user-participatory usability testing for information appliances with particular focus on idea-generative aspect. Tool called RUTIA (Remote Usability Testing for Information Appliances) was developed for allowing user to participate usability testing in his own computer through web. All the data generated while user is participating usability testing session are automatically sent to the server, which makes it very easy to collect usability data. With RUTIA, users can drag cards of interface elements directly and build the interface structure in their own from their computer-screen so that they can represent their mental models on interface structure of testing product (card-sorting). Besides, users can also directly participate to layout the control buttons of testing products by simple drag and drop. This function of users' direct involvement can improve the method of usability testing by reinforcing idea-generative aspect which has been neglected by conventional usability testing methods. A case study with the application of the tool showed that the tool is very valuable to understand users' conceptual models of product.

Key words: *Usability Testing, User-Participatory Design, Idea Generation*

1. Introduction

Since the emergence of information society, the application of computer technology for product has made a new type of product come into being, so called 'information appliance' which is defined 'a computer-enhanced consumer device dedicated to a restricted cluster of tasks' [1]. Naturally, the introduction of information appliance has brought about the change of the design approach for the product for two main reasons: very wide base of non-expert-consumers and different characteristics of information appliance itself. In turn, with the substitute of microchips for mechanical parts in information appliances, the product has become less tangible and 'black box', which makes the key success factor of product as 'the usability: the capability to be used by humans easily and effectively' [2]. The major benefits of usability testing listed include 'reduced customer support, service and training costs', 'avoidance of costly delay in schedule', 'simpler-to-prepare product documentation' and 'accurate, ready-to-use marketing claims based on tests' [3]. However, despite of the advantages of usability testing, usability testing in the environment of closed laboratory has been known to cause some significant problems: high cost, unnatural environment and limited focus only on measurement. Particularly, a session of usability testing

focuses mainly on ‘measuring’ aspects: i.e. a researcher focuses on evaluating the degree to which a product meets specific criteria. As a result, types of data from a session of usability testing include data on time duration for performing tasks, number of errors, percentage of tasks completed successfully, ratings or rankings of the product, and number of negative references to the product. However, users’ suggestions for new idea are also as much important as measuring the usability. The participatory design approach has been known to be very useful to elicit users’ tacit and latent needs, and thus can provide abundant data on user’s cognitive process for design. Participatory design process uses stakeholders’ collective generativity rather than a designers’ individual creativity to solve design problems that are very specific to the context. By analyzing what users create, researchers can elicit users’ tacit needs, which cannot readily be expressed in words. This research aims at developing the prototype of tool which can allow users to actively participate in generating ideas for interface design with the application of World Wide Web technology. Objectives in further detail are as follows:

- Use web for automating usability session
- Allow users to participate the usability session in their own natural environments.
- Let users participate in idea generation as well.
- Make the way of collecting and analyzing tested data as simple as possible

2. User Participatory Design for Interface Design

While traditional design research methods focus primarily on observational research and questionnaire, participatory design focuses on what people make to elicit what they think, feel and dream. By having workshops and discussing design issues with users, managers, and sales people, designers can discover problems that are very specific to the context. In the user-participatory design workshop, designers use so-called ‘Make Tools’ (or generative toolkits) to connect ideas of users from different disciplines and perspectives. Participants use this ‘quick-and-dirty’ prototyping to visualize their thoughts in the generative phase of design process, which designers analyze to understand their needs. Whereas the user needs collected from the conventional methods are based on explicit knowledge or observable behavior, the needs elicited from participatory design are based on tacit knowledge, which cannot readily be expressed in words. Some methods for user participatory design have been developed such as ‘exploratory test [4]’, ‘card sorting’, ‘scenario-based design [5]’, ‘collaging’, ‘Velcro modeling’, and ‘cognitive mapping’ [6]. Particularly, among these methods, card sorting and Velcro modeling are widely used in interface design for their simplicity and low cost. They are particularly useful for understanding user’s mental model on information architecture of interface design and the layout of control buttons of product. In card sorting, users play with cards on which names of individual interface elements are written, and they are asked to group the cards according to the structure as they think how interface is structuralized. (Figure 1-A) There are two types of card sorting. One is with head card where users are asked to group cards of interface elements under pre-defined category and the other is without head card where users freely group cards without any specific pre-defined category [7]. While card sorting is helpful to understand users’ mental model of interface structure in software, Velcro modeling is particularly useful to recognize how users think about the layout of hardware interface elements like control buttons or display of product. In Velcro modeling, users use control buttons made of cardboard with Velcro attached and place control buttons on the surface of cardboard which reflects users’ own mental model on the layout of control buttons. (Figure 1-B)



Fig.1-A User Participating in Card Sorting



Fig. 1-B Example of the Result of Velcro Modeling [8]

However, even their usefulness of understanding user's mental model on interface design, they are still problematic in some respects. At first, these methods are highly costing because of preparation of lab facilities including space usually with one-way mirror, video camera, recording tools, computers for data logging, and diverse software for analysis. Secondly, users cannot fully participate in idea generation due to the unnatural closed lab environment where user is left alone to perform card sorting or Velcro modeling. Finally, these methods require users to be recruited and physically brought in lab, which limits seriously the number of participants.

3. RUTIA: Remote Usability Testing for Information Appliances

In order to overcome limits of current user participatory idea generation mentioned above, a prototype named RUTIA was developed at Human Centered Interaction Design Lab in Korea Advanced Institute of Science and Technology. RUTIA stands for remote usability testing for information appliance. As the name of RUTIA shows, the 'remoteness' is the core concept of the tool for several reasons. At first, by allowing users to participate usability testing from remote location, they can freely participate in their own spaces at any time. In turn, this remote access of usability testing can solve the problem of unnatural atmosphere and high cost. In addition, this relatively easy access to usability testing from user's own comfortable location allows considerably more number of users to participate than only few invited users in closed lab environment. Actually this remote user study is nothing new and there are already many types of methods of remote user study available. Those include 'third-party laboratory evaluation', 'third-party usability inspection', 'remote questionnaire or survey', 'collaborative remote evaluation', 'video-conferencing-supported evaluation', 'instrumented or automated data collection for remote evaluation' and 'user-reported critical incident method' [9]. Among these methods instrumented or automated data collection method is most appropriate for the purpose of remote user-participation. The method refers to instrument some application program to automate the collection of a log of data occurring as a natural usage in users' normal working environments. Once user downloads and installs an application program in his or her computer, all the user should do is just to work normally as usual in his own environment. Then the application program takes care of collecting and reporting data such as program usage, project time, internet usage, comments to usage, keystrokes and mouse movements, and any other activities. The RUTIA was developed with

the application of these basic characteristics of automated data collection: ‘remoteness’, ‘asynchrony’, ‘natural environment’, and ‘simple management’. The RUTIA uses internet environment to allow users to participate the session in their environment because internet is nowadays most widely available for ordinary users. For the participation, remotely located users are required to download web browser in their own environments and once downloaded, they use internet as usual without any extra change or extended effort.

3. 1. Structure and Process of RUTIA

The RUTIA comprises of three basic modules: testing, idea generation, and analysis as shown in Figure 2. At first, user is guided to the overall process and is introduced the nature of RUTIA, and then he is asked to fill out pre-questionnaire to identify himself like demography, product experience and so forth. It is followed by simple warming-up session which is prepared for user to get familiarized with the web-based usability testing. In warming-up session, simple task such as setting up time or flipping the mobile phone is given to user and user performs the task given on the screen until he feels confident enough to continue to the next stage of main testing. After warming-up session, user is guided to the session of main testing where user performs series of tasks given for product on usability testing. User uses mouse to perform the tasks by pressing control buttons on the computer-simulated product which responses exactly same as real product like sound, display or other various states. Testing session continues to ‘Idea Generation’ which is the main concern of this paper. In the module of idea generation, users participate in generating ideas of layout of interface control buttons and structuring information architecture. This part will be separately dealt in further detail later. Finally in the analysis module, all the automatically collected data saved in server is analyzed in various ways: time taken to perform the tasks, errors made while performing the tasks, and so on. However, most invaluable feature of RUTIA lies in replaying all user interaction process. All the interacting processes by users while they were engaging the usability testing are replayed with the exactly same operational paths, sequences and time. The operational traces are visualized in line over the product so that analyzer can easily see how user interacted, moved around, made errors and so forth in sequence. This replay is done with the interface like on VCR: a researcher can stop, pause, play, fast forward or rewind by clicking control buttons.

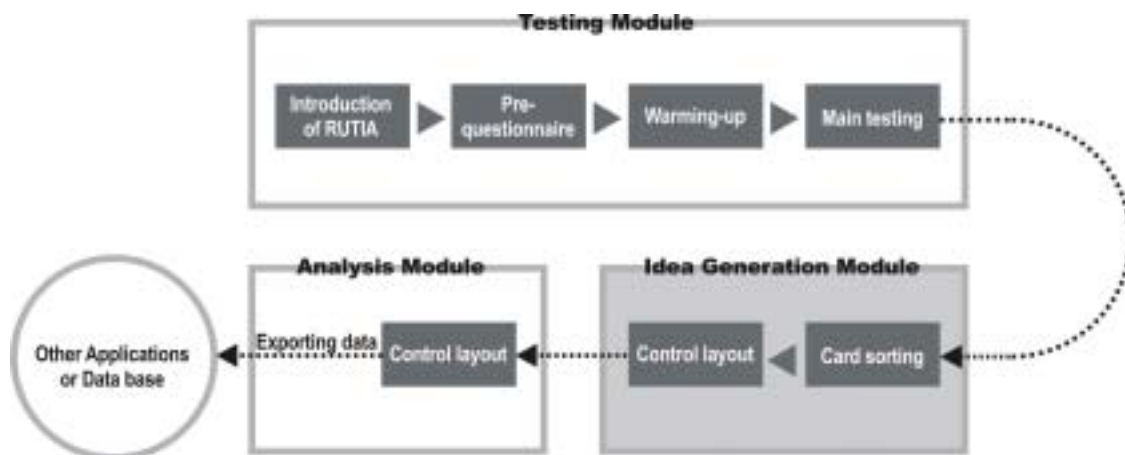


Fig. 2 The Structure and Process of the Tool, RUTIA

3. 2. Web Card Sorting

In the idea generation module, at first, user is guided to participate in card sorting as a way of understanding representing his or her mental model regarding the interface structure of product on testing. Rationale behind the card sorting is same with conventional card sorting described earlier in section 2. However, operating mechanism is quite different in RUITA. Instead of playing with physical paper card, in RUITA, user interactively manipulates with computer and he drags cards on the screen to group, name, and make category. In detail, card sorting session starts with warming-up session for informing user of how to practice web-based card sorting with small number of cards. After warming up, user gets involved in main task of card sorting. All the cards with name on them are randomly arranged on the screen as shown in Figure 3. He makes a new folder (categorical group) into which highly related cards are dragged and grouped. User can create as many folders as he wants. If necessary, a folder may be deleted and cards are regrouped. While sorting the cards, if user cannot understand the name written on the card, he can move the cursor over the card and stay for a moment for getting the hint of name. Then the textual meaning of the name of card is shown inside balloon shape of box. Subfolders can be also created inside of a folder if user needs make subgroup within the group. After completing grouping the cards, user is asked to name the folders. Alternatively, user is asked to group cards with readymade folders with headers. In this case, user just moves cards into readymade folders. After finishing grouping cards, user is guided to rename those cards which he could not understand very well due to the ambiguous notation of name. The selection of cards for renaming is made based on whether he got hint of name while sorting cards. Finally the session of card sorting is finished with debriefing users. In the debriefing session, user is interviewed by questions like what the difficult part of the session was or why he changed the specific name. Those questions are automatically generated based on user interaction data saved on server. In the analysis module, all the user's interaction behavior is replayed and visualized as shown in Figure 4: how user dragged cards, created folders and so forth. Small window in the right-upper part is the place where user's interaction behavior is replayed with the VCR type of interface shown right underneath of replaying window. The table shown in the left-lower part is the statistical table which summarizes time taken for each interaction behavior.

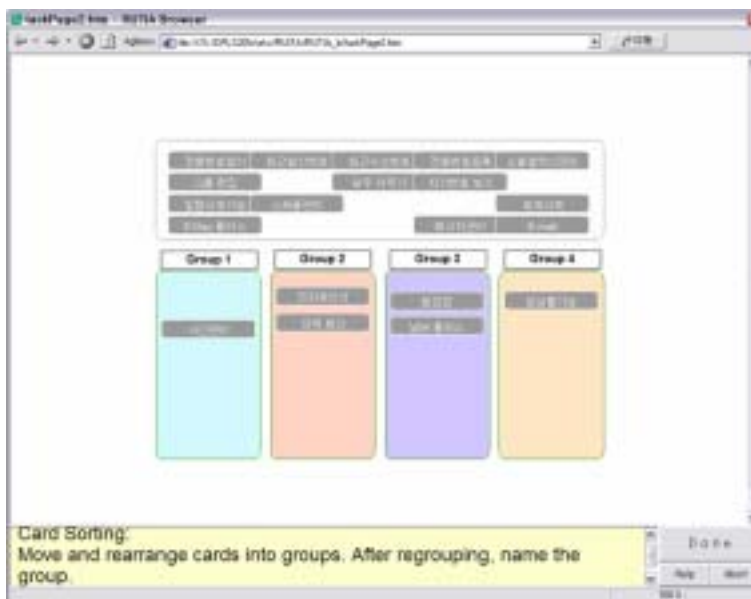


Fig. 3 Sample Screen of Card Sorting



Fig. 4 Analysis of Card Sorting

3. 2. Layout of Control Buttons

After card sorting, the idea generation module is continued. However, this time, idea generation is done with physical control buttons of product, not with abstract cards. This session is prepared to understand how user perceives control buttons should be arranged in layout. How the layout of control buttons should be has been critical issues in user-interface design and human factors as well. Again, like in the session of card sorting, user participates in layout of control buttons in simple click and drag mode. At first, an empty product without any control buttons and a set of control buttons are separately shown on the screen as shown in Figure 5. Then user is asked to design the layout of control buttons by dragging buttons in places where he thinks appropriate. He can freely move buttons around and create his own layout. Similarly with the case of card sorting, the entire user's behavior shown during layout of control buttons can be replayed and visualized in the analyzing module.

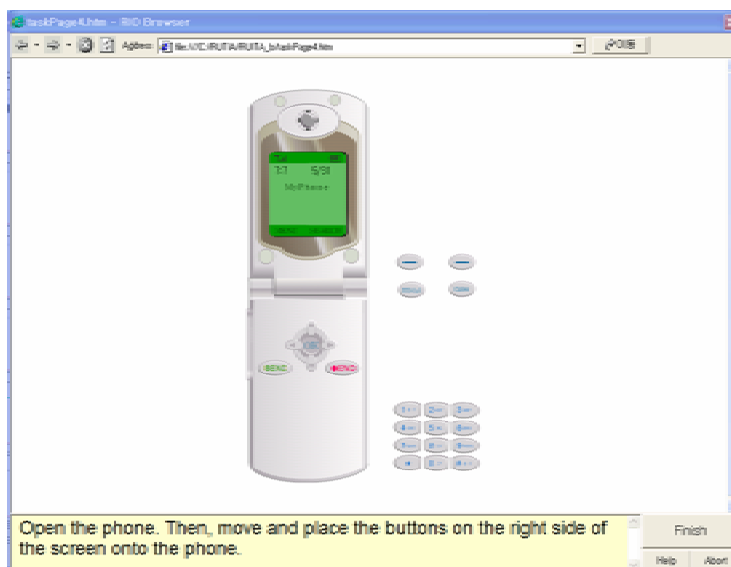


Fig. 5 Sample Screen of Layout of Control Buttons

4. Conclusion and Further Works

RUTIA is currently still in the stage of prototype and it needs further validation through the application for real usability testing projects. The RUTIA as a tool for web-based user-participatory idea generation shows several potential values: low cost of management, easy collection of data, short time to conduct usability testing, provision of natural atmosphere to user, user's active participation of idea generation, and availability of diverse ways of insightful analyses.

However, RUTIA still has rooms for further development in several respects. At first, since the tool is mainly based on web environment, user loses the reality of product. No matter how real the product on the screen is, the product is not still real but only two-dimensionally simulated. Particularly, if product is not flat shape with control buttons located only on one surface but with buttons scattered around multi-surfaces, it becomes to difficult to simulate in two dimension. In addition, revolving knobs or toggle switches are difficult to realistically operate by mouse. Size of product is another issue in simulated product: product bigger than computer screen cannot be presented as real scale. The other point for further development is one-way usability testing. Once browser of usability testing is downloaded by user, there is no way for researcher to interact with user participating in usability testing. User is entirely separated in his remote environment. Researcher does not have any control of usability testing and cannot get any other contextual data such as user's particular gesture or facial expressions. Finally, internet environment can limit the type of participating users those who can access easily web.

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