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Usability Heuristics for Interactive Digital Television

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Abstract— Usability evaluation for applications based on emerging information technology brings new challenges. Interactive Digital Television (iDT) is considered as the convergence of television and computer technologies. The main iDT feature is that the user may interact with the application; therefore usability should be a main concern when designing iDT applications. Current research usually focuses on iDT applications from a technical point of view, rather than a user-centered approach. There is a need for new usability evaluation methods or at least for the use of traditional evaluations in novel ways. A set of heuristics is proposed, in order to help the usability evaluations of iDT applications.

Keywords- usability, usability heuristics, interactive digital television

I. INTRODUCTION

Interactive Digital Television (iDT) is considered as the convergence of television and computer technologies, which gather three typical features: interactivity, customization and digitization [1]. The iDT exceeds the analog TV in several aspects: capacity, better use of the spectrum, greater immunity to noise and interference, better sound and picture quality, potential for transmission of data simultaneously, saving power transmission. However, the main iDT advantage is that the user may interact with the application [2].

Usability evaluation for applications based on emerging information technology brings new challenges. Is it the classical concept of usability still valid? Which are the dimensions of the (new) usability? How can it be measured? How should we develop for (better) usability? There is a need for new evaluation methods or at least for the use of traditional evaluations in novel ways [3].

The ISO/IEC 9241 standard defines the usability as the extent to which a product can be used by specified users to achieve specified goals with effectiveness, efficiency and satisfaction in a specified context of use [4]. Usability

evaluation methods are commonly divided into inspection and testing methods. Inspection methods find usability problems based on the expertise of usability professionals. Testing methods find usability problems through the observation of the users while they use (and comment on) a system interface.

Usability evaluation is needed particularly if the design concept is new. Users look for more than just a usable product; they look for a pleasing and engaging experience [5]. Therefore, usability should be a main concern when designing interactive iDT applications. Current research usually focuses on iDT applications from a technical point of view, rather than a user-centered approach. There is a necessity to establish methodologies that could lead to applications with a high level of usability. Such methodologies have to include accurate usability evaluations.

Heuristic evaluation is a widely used inspection method [6] [7]. A group of evaluators (usually from three to five) inspect the interface design based on a set of usability heuristics. In order to ensure independent and unbiased evaluations, the inspection is performed individually. After all individual evaluations have been completed, the evaluators are allowed to communicate and have their findings aggregated in a single list of usability problems. Later on, each evaluator assigns scores to each problem's severity and frequency (on a 0 to 4 scale, from minor/less frequent to major/more recurrent). Severity and frequency are summed in order to get problem's criticality. Problems are ranked based on their average severity, frequency and criticality. The usability evaluation report includes usability problems, solution proposals, as well as positive findings.

Heuristic evaluation is easy to perform, cheap and able to find many usability problems (both major and minor problems). However, it may miss domain specific problems. That is why the use of appropriate heuristics is highly significant.

The paper focuses on usability heuristic evaluation of iDT applications. A set of 14 specific usability heuristics is

proposed. Section 2 presents the methodology that has been used in heuristics' development. Section 3 highlights the main characteristics of iDT applications. The iDT usability heuristics proposal is presented in section 4. Section 5 presents preliminary conclusions and future works.

II. DEFINING USABILITY HEURISTICS FOR INTERACTIVE TELEVISION

In order to develop usability heuristics for iDT, a specific methodology was applied [8]. The methodology to establish new usability heuristics includes 6 stages:

- **STEP 1:** An *exploratory* stage, to collect bibliography related to the main topics of the research: specific applications, their characteristics, general and/or related (if there are some) usability heuristics.
- **STEP 2:** A *descriptive* stage, to highlight the most important characteristics of the previously collected information, in order to formalize the main concepts associated with the research.
- **STEP 3:** A *correlational* stage, to identify the characteristics that the usability heuristics for specific applications should have, based on traditional heuristics and case studies analysis.
- **STEP 4:** An *explicative* stage, to formally specify the set of the proposed heuristics, using a standard template.
- **STEP 5:** A *validation* (experimental) stage, to check new heuristics against traditional heuristics by experiments, through heuristic evaluations performed on selected case studies, complemented by user tests.
- **STEP 6:** A *refinement* stage, based on the feedback from the validation stage.

An early version of the iDT usability heuristics was proposed in 2009 [9]. Later on, STEP 1 to STEP 4 of the methodology were performed, and a refined usability heuristic proposal was defined. As no specific iDT usability heuristics were found, the proposal is based on the well-known and widely used Nielsen's 10 heuristics [7]. However, heuristic proposals for other fields, such as Social TV, Virtual Worlds and Grid Computing were also used. STEP 5 and STEP 6 are yet to be performed.

III. INTERACTIVE DIGITAL TELEVISION CHARACTERISTICS

Nowadays the concept of television does not refer to a specific device, but rather a specific kind of content available almost everywhere, freeing television from the TV set and bringing it out of home. Additionally, current trends combine iDT and the web; users may navigate on internet from their TV sets, download and use applications, download content or customize the TV schedule.

iDT applications have a set of basic features that should be considered when evaluating their usability:

- **Interactivity:** iDT applications should offer bidirectional communication, a fundamental requirement of any interactive system. An iDT application should invite

user to participate, in order to have a more active experience while watching content. Interactivity is the ability to offer additional content to the television programs, allowing the user to view associated information with audiovisual content, to view the TV channels' schedule, to participate in contests, polls, to buy products or services, and even to participate in the television programs creation/customization.

- **Customization:** iDT applications should allow customization in terms of content, appearance and others, taking into account users' needs, skills, personal preferences, etc.
- **Physical features of interaction:** Human vision is optimal at a particular distance from the screen; therefore, iDT applications should take into account screen resolution and contrast. Traditionally, users watch TV in an environment that is oriented to relaxation and comfort. However, nowadays users can access this medium in various environments, from multiple devices (TV sets, phones, etc.) and using different technologies (high-definition, 3D, etc.).
- **Consistency of applications and content:** iDT applications should be related to the content itself, and relevant for specific users.
- **Adaptability:** iDT applications should be adaptable to different target public and environments. They should even suggest content/programs based on users' preferences and history of selection (among others).

IV. A USABILITY HEURISTICS PROPOSAL FOR INTERACTIVE TELEVISION

iDT usability heuristics were specified using the following template:

- **ID, Name and Definition:** Heuristic's identifier, name and definition.
- **Explanation:** Heuristic's detailed explanation, including references to usability principles, typical usability problems, and related usability heuristics proposed by other authors.
- **Examples:** Examples of heuristic's violation and compliance.
- **Benefits:** Expected usability benefits, when the heuristic is accomplished.
- **Problems:** Anticipated problems of heuristic misunderstanding, when performing heuristic evaluations.

The 14 proposed usability heuristics were grouped in three categories: (1) *Design and Aesthetics*, (2) *Flexibility and Navigation* and (3) *Errors and Help*. A summary of the proposed heuristics is presented below, including heuristic's ID, name, definition and explanation.

Design and Aesthetics Heuristics:

- (H1) **Match between the system and the real world:**
An iDT application should speak the user's language, with

words, phrases and concepts familiar to the user. iDT applications should use specific conventions of the real world and should show the information in a natural order. The sequence of activities should follow user's mental processes. Metaphors should be easy to understand; there should be an intuitive mapping between controls and their functions.

(H2) **Simplicity:** *An iDT application should not overload users with irrelevant and/or unnecessary information.* Every extra unit of information competes with the relevant units of information and diminishes their relative visibility. iDT applications should show concise (but all necessary) information.

(H3) **Consistency and standards:** *Design should be coherent and consistent throughout the iDT application; it should follow the norms or conventions for TV design in general, as well as for new specific elements of iDT.* iDT applications should present similar elements in similar ways. Terminology, controls, graphics and menus should be consistent throughout the system; there should be a consistent look and feel for the system interface. As there are not yet widely recognized standards for iDT applications, highlights the importance of the consistency over standards.

(H4) **Feedback:** *An iDT application should provide feedback to the user, at least when he/she is performing key actions.* iDT applications should provide feedback on user's key actions, in a clear manner and within a reasonable time. User should be able to clearly identify their location into the application, and the available options.

(H5) **Physical constraints:** *An iDT application's elements should be visible at the visual range of watching TV, and in various types of lighting.* iDT applications design should consider issues related to the size, distances between elements displayed on screen, lighting, and others environmental factors. The concept of television is being redefined, television becomes ubiquitous; therefore specific factors should be considered.

(H6) **Extraordinary users:** *An iDT application should be inclusive, attending (all) special users' needs.* iDT applications should at least use appropriately color restricted and provide alternative mechanisms for users with hearing problems.

Flexibility and Navigation Heuristics:

(H7) **Structure of information:** *An iDT application should organize information hierarchically, from general to specific.* Related pieces of information should be clustered together; the amount of information should be minimized; option, titles and headlines should be straightforward, short and descriptive.

(H8) **Navigation:** *An iDT application should allow simple navigation; user should easily move through the*

application and locate information of interest. iDT applications should provide navigational feedback (e.g. showing a user's current and initial states, where they have been, and what options they have for where to go) and navigational aids (e.g. find facilities).

(H9) **Recognition rather than recall:** *The iDT application's main elements and options should be always kept available; user should not have to remember information from one screen to another.* Help and instructions should be visible or easily accessible when needed; relationship between controls and their actions should be obvious; input formats and units of values should be indicated.

(H10) **Flexibility and efficiency of use:** *An iDT application should allow a wide range of user expertise; it should allow users to personalize the application according to their skills; it should adapt to different environments.* iDT applications should offer appropriate guide to novice users. Experienced users should get appropriate mechanism to customize applications according to their needs, skills, and personal preferences.

(H11) **User control and freedom:** *An iDT application should offer users control over their actions and should allow free exploration.* iDT applications provide "undo" (or "cancel") and "redo" options; exits should be clearly marked (when users find themselves somewhere unexpectedly); facilities to return to the top level should be provided, at all stages. Facilities to return to previous points and to the main screen should be provided, from anywhere in the application. Users should be able to freely explore the application, without castigation.

Errors and Help Heuristics:

(H12) **Error prevention:** *An iDT application should provide appropriate mechanisms to prevent errors.* iDT applications should provide appropriate messages in order to prevent users' errors. User confirmation should be required before carrying out a potentially "dangerous" action (e.g. deleting important information).

(H13) **Recovering from errors:** *An iDT application should provide clear messages, hopefully indicating causes and solutions for errors.* Error messages should adequately describe problems; they should assist in diagnosis and suggest ways of recovery in a constructive way; error messages should be written in a non-derisory tone and refrain from attributing blame to the user.

(H14) **Help and documentation:** *An iDT application should provide users a clear and simple help, in their own language.* iDT applications should offer clear, direct and simply help, expressed in user's idiom, free from jargon and buzzwords; help should be easy to search, understand and apply.

When refining the usability heuristics proposal, a usability checklist was also defined. It details the set of 14 heuristics in order to help their use in heuristic evaluation practice.

As Table 1 shows, a mapping can be made between iDT 14 heuristics and Nielsen's 10 heuristics. However, as the heuristics' specification shows, the proposal is not just a particularization of Nielsen's heuristics.

TABLE I. MAPPING BETWEEN iDT HEURISTICS AND NIELSEN'S HEURISTICS

iDT Heuristics		Nielsen's Heuristics	
ID	Definition	ID	Definition
H1	Match between system and the real world	N2	Match between system and the real world
H2	Simplicity	N8	Aesthetic and minimalist design
H3	Consistency and standards	N4	Consistency and standards
H4	Feedback	N1	Visibility of system status
H5	Physical constraints	N8	Aesthetic and minimalist design
H6	Extraordinary users		
H7	Structure of information	N7	Flexibility and efficiency of use
H8	Navigation	N3	User control and freedom
H9	Recognition rather than recall	N6	Recognition rather than recall
H10	Flexibility and efficiency of use	N7	Flexibility and efficiency of use
H11	User control and freedom	N3	User control and freedom
H12	Error prevention	N5	Error prevention
H13	Recovering from errors	N9	Help users recognize, diagnose, and recover from errors
H14	Help and documentation	N10	Help and documentation

Heuristics H1, H3, H4, and H9 particularize Nielsen's heuristics N2, N4, N1, and N6 (respectively), based on iDT applications' characteristics. Heuristics H12, H13 and H14 put Nielsen's heuristics N5, N9 and N10 (respectively) into the context of iDT applications. Heuristics H2, H5 and H6 particularize Nielsen's N8 heuristics. Heuristics H7 and H10 denote Nielsen's N7 heuristic. Heuristics H8 and H11 detail Nielsen's N3 heuristic.

V. CONCLUSION AND FUTURE WORKS

As iDT is nowadays a reality and the number and type of users is growing fast, the usability of iDT applications became a main issue. There is a need for new usability

evaluation methods or at least usability evaluations should be particularized for iDT applications.

A set of 14 specific usability heuristics and an associated usability checklist were developed. As no specific iDT usability heuristics were found, the proposal is based on the well-known and widely used Nielsen's 10 heuristics as well as on heuristic proposals for other fields (such as Social TV, Virtual Worlds and Grid Computing). However, as the heuristics' specification shows, the proposal is not just a particularization of Nielsen's heuristics; the set of 14 usability heuristics was specifically designed for iDT applications.

As future work, the proposal has to be validated through experiments. Heuristic evaluations will be performed, in order to check the iDT usability heuristics' potential in practice. Heuristic evaluation experiments will also provide an important feedback for heuristics' refinement.

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