USABILITY HEURISTICS FOR ONLINE VIRTUAL WORLDS

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Abstract. This paper explores a set of usability heuristics developed for the EU FP7 ICT VirtualLife project. The purpose of the project is to create a three-dimensional online virtual world – in the form of a safe, democratic and legally ruled collaboration platform. 3D virtual worlds are a relatively new expression of online communication and collaboration tools. The most essential aspect – usability – still is in tentative phase. Consequently, conventional usability heuristics are not suitable for 3D virtual worlds. The paper identifies major differences between 3D virtual worlds and other online collaboration and communication tools. Specific user needs are discussed considering the users' real experience, mistakes and problems.

Keywords: virtual world, usability evaluation, heuristic evaluations, online communication and collaboration, user research, user needs.

1 Introduction

The paper presents the results of an analysis that was performed in order to obtain usability heuristics while developing the VirtualLife[1] virtual world platform. VirtualLife is an ongoing 36 month project awarded by the European Commission to 7 small enterprises and 2 universities. The project is aimed at developing of a 3D immersive collaborative virtual environment with a number of innovative features such us secure and trusted communication, virtual legal system, dispute resolution mechanism, user reputation management system and a peer-to-peer network communication architecture. The platform is intended for business and education [1].

We distinguish two types of virtual environments:

- the fully immersive virtual reality environment where user is equipped with shutter glasses to give stereoscopic views and pinch gloves for manipulation,
- the non-immersive desktop web-based virtual environments where three-dimensional photorealistic view is displayed on a desktop and user as an avatar manipulates the virtual objects through the graphical user interface.

In this paper we deal with the latter three-dimensional non-immersive desktop virtual environment and call it virtual world. Virtual world enables many users to interact, navigate and experience a synthesized world in real time. User is able to develop, alter and submit content as well.

In recent years the development of virtual worlds has greatly increased. At present, wide spectrum of products with various features and characteristics exists. The need to conduct a formative evaluation of the first prototype of VirtualLife platform encouraged us to study usability heuristics devoted to social collaboration and communications platforms. We define heuristic as design principle that is used to evaluate system usability. A heuristic evaluation is an informal usability inspection method for finding usability problems in a user interface. The interface is examined by 4 – 5 trained evaluators that judge its compliance with usability principles [9], [10].

The attempts to perform heuristic evaluations are made for both kinds of virtual environments. The heuristics for usability inspection for fully immersive virtual reality environments reflect the sense of presence, sense of immersion and haptic feedback [14]. The heuristics inspections in virtual worlds were performed using the traditional usability heuristics for graphical user interfaces [17]. However, virtual worlds raised sociability as a new aspect of software applications. This aspect is not covered in the initial set of heuristics. Therefore we need to redesign the initial set of heuristics in order to have a specialized set devoted to virtual worlds.

In this paper we develop a set of usability heuristics for virtual worlds. We deal with distinctive features of virtual worlds which gave us the means to define uncovered aspects of existing heuristics defined for 2D social communications and collaborations environments also called Web 2.0 environments. It is important to stress that sociability aspects in virtual worlds serve the same purposes as in Web 2.0 environments. Only the presentation of the communication context differs: in Web 2.0 communication appears in text-based environment whereas in virtual worlds communication appears in photorealistic three-dimensional environment. Therefore we state that successful experience of the implementation of sociability aspects in Web 2.0 environments is a useful background defining the usability heuristics for virtual worlds. It is important to

[1] The research is supported by EU FP7 ICT VirtualLife project, 2008-2010, see http://www.ict-virtuallife.eu

understand which sociability aspects of Web 2.0 environments should be implemented in virtual worlds as well as how they should be implemented in order to improve the user' communication experiences.

In the following sections we analyze social communication mechanisms that have to be supported in virtual worlds. Definition of specific virtual world user needs support the selection of relevant heuristics dedicated for the evaluation of Web 2.0 environments. Our analysis of virtual world users' forums permits us to study the usability defects in existing virtual worlds. Users' comments allowed us to find the gaps and to append the defined set.

2 Features of 3D virtual worlds

Three-dimensional virtual worlds distinguish for their features from a wide set of 2D online collaboration and communication tools also called Web 2.0 tools. Several of those features are essential with regard to usability [19].

Two- and three-dimensional collaboration and communications environments have the important common feature: information there cannot be controlled as users create and manipulate the bulk of content. The most popular environments even encourage users to perform these activities. Hence, the concept of audience vanishes in 2D and 3D collaboration and communication environments. Users become more participants in knowledge creation than consumers of prepared data.

The distinct feature of three-dimensional spatial information delivery manner is the need of specific navigation. In a typical hierarchy of information arrangement, it is possible to group data into logical sections or trees. In this case the data structure restricts or predicts every item of information which is always seen. However, the three-dimensional spaces cannot be structured or recognized in such a manner as users navigate in a totally different way. The navigation is performed as in the real world. Users of 3D virtual worlds link together information and its place of storage with virtual objects.

The graphical user interface in 3D virtual worlds substantially differs from traditional interfaces [15]. The main differences are unique input-output devices and implementation of interaction between users. Traditional usability engineering methods for evaluation of virtual worlds interface are suitable, but partially. Stanney and Cohn suggest considering the following aspects in order to evaluate the graphical user interfaces in a 3D virtual world [15]:

- Integration of input-output devices
- Navigation
- Intuitiveness and simplicity of objects manipulation
- Comfort of system design

Additional and the unique usability aspect is the sense of presence which derives from exclusiveness of 3D virtual worlds – imaginary transportation between various virtual places [15]. To support such transportation the world should provide immersive content, realistic movement and interaction control tools.

3D virtual worlds are an innovative and evolving area of information technologies. They need an additional research in order to ascertain how users intend to use navigation tools and communicate with other users or virtual objects in 3D virtual reality.

3 Social mechanisms for communication and collaboration

Communication and collaboration tools should be created considering the social practice. It is important to cover social mechanisms which have a critical influence to product success. Major social mechanisms are conversation, coordination and awareness [11].

Designing communication and collaboration tools, it is essential to define how the various forms of conversation will be supported. For example, the system can use e-mail, videoconferencing, videophones, chat rooms or messaging. Besides, the decision regarding conversation support tools is always influenced by the type of communication, as it can be synchronous or asynchronous. In 3D virtual worlds it becomes possible to render a high quality synchronous realistic communication and use additional visual aids supporting the discussion.

The success of group work often depends on coordination. And there is no difference if the group works in a real or virtual environment. There are several coordination mechanisms which can help to implement this activity properly [3]:

- Verbal and non-verbal communication
- Schedules, rules and conventions
- Shared external representations

Coordination mechanisms can also be formal or informal. However, all of them should be socially acceptable and chosen to keep system's balance. Too strict coordination can be frustrating whereas the lack of control leads to a chaos.

The concept of awareness covers the rendering of surrounding activities. This is the most difficult task for the developers of communication and collaboration tools. It is important to eliminate communication barriers which emerge because of physical distance. Awareness technologies support a communication between distance collaborators. The following examples illustrate the application of awareness technologies:

- "Portholes" – the system which renders the video view from different workplaces in real time [4]
- "Babble" – the chat room where visitors are represented as colorful balls which inform about the amount of active users and observers [2]
- "Tickertape" – the instant messaging system which displays users' messages scrolling across the screen. This kind of tool allows the remote visitors to chat, send requests and organize their activities [5]

4 Specific user needs in 3D virtual worlds

Specific user needs is the base for usability research in 3D virtual worlds. In principle, these needs derive from the distinction of three-dimensional virtual worlds. This section discusses major user needs which should be met in virtual worlds [6], [7].

4.1 Presentation

Graphical user interface being the link between user and system is always an important component in every software product**.** This aspect is critically important for the success of 3D virtual world as well. In order to render rich, wide and photorealistic views, the system should be based on innovative and modern technologies. However, it is essential to consider a part of users who use older and slower hardware. Hence, the system should be able to identify such features of users' hardware.

Avatar is a virtual representation of every user, which has a set of individual qualities. Consequently, user's wish to transfer his personality into virtual reality should be met. Virtual world should offer a set of predefined avatars of both genders, various age and appearance. User should be able to change these attributes at any time as well.

4.2 Activity

One of the most often performed activities in virtual worlds is user interaction between each other or with virtual objects. A user expects that general real world physical interaction rules will be obtained in a virtual world. Therefore the interaction between avatars must be as realistic as possible. Additionally, such activities must conform to the ordinary rules of logic. For example, some virtual spaces might be public for all visitors and others could limit the visiting availability. Private and public modes are also essential for user communication which is commonly based on text or voice chat.

Avatar movement is required in almost every user task in a virtual world. This movement be as simple and intuitive as possible. Avatars should be able to perform all general movements: walking, running, sitting, looking around, etc. Ability of flying and teleportation are additional but also important forms of movement in 3D virtual worlds.

As already mentioned, 3D virtual world users become more content creators than consumers. An idea of virtual worlds is to give users the ability of content creation and manipulation. It is required to provide tools for external object import as well. Parallel to virtual objects creation, advanced users are interested in extending the functionality of the virtual world or objects. Hence, additional tools (usually a scripting language) should be provided.

4.3 Rules

A basic set of rules should be created and applied to every item of a virtual world in order to control the usage of virtual objects. These rules are intended to specify licensing and intellectual protection. The virtual world should define object ownership policy – the rules to modify, copy or create objects.

5 Conventional usability heuristics are not sufficient for 3D virtual worlds

In order to evaluate the sufficiency of conventional usability heuristics for 3D virtual worlds, the accomplished research was divided into several phases.

The result of the first phase was a collection of various features of sociability and usability for 2D online collaboration and communication tools. These features were collected with references to publications ([12], [13], [16], [18], [8], [3]) that discuss the usability and user needs in 2D online communication and collaboration tools.

During the second phase all gathered data was grouped and summarized in order to produce a structured set of sociability and usability heuristics for 2D online communication and collaboration tools. The list was

divided into sociability and usability parts, later separated into subgroups. The phase was ended with 13 sociability and 34 usability heuristics.

Sociability (S):

S1. The purpose of virtual community

S1.1. Virtual community has a clear and meaningful name

S1.2. Purpose of virtual community is stated, defined clearly and briefly

S2. Members and their activity

S2.1. Virtual community has members

S2.2. Each member has an account in virtual community

S2.3. Each member is able to form groups and communities, which unify members of the same interest

S2.4. Virtual community implements clearly separated user roles

S2.5. Attendance of member in virtual community is visualized in a particular manner

S2.6. Virtual community supports, motivates and promotes active members

S2.7. Virtual community supports, motivates and promotes the continuous participation

S2.8. Virtual community supports, motivates and promotes effective communication and collaboration

S3. Rules

S3.1. Virtual community has rules which define the control of users' registration and their attendance in virtual environment

S3.2. Virtual community has rules which control the behavior of community members

S3.3. The system has administrator

Usability (U)

U1. Navigation

U1.1. It is easy to learn how navigation is performed

U1.2. Navigation is intuitive and memorable

U1.3. Minimal use of additional windows

U1.4. Minimal use of deep hierarchical structure

U1.5. The system ensures the consistency between navigation information

U2. Accessibility

U2.1. The system evaluates if user has a sufficient set of devices and tools in order to use distance communication and collaboration tools

U2.2. The system predicts the possible problems related to technical barriers and has a set of predefined solutions

U2.3. Technical requirements are clearly defined

U2.4. The system ensures a short time for downloading and installing the tool

U3. Information delivery and presentation

U3.1. The system ensures the convenience of information transfer, acquirement and search.

U3.2. The system provides only complete and updates information

U3.3. Redundant usage of colors is avoided

U3.4. Usage of animated and graphical elements is limited

U3.5. Information is delivered consistently and coherently

U3.6. The system provides help for users

U4. Dialog

U4.1. The system ensures that protocol of dialog usage can be easily learned

U4.2. The user controls the system behavior, not vice versa

U4.3. The system response is predictable

U4.4. The system response is informative

U5. Security

U5.1. The system provides tools for error managing

U5.2. The system prevents user from making mistakes. However, if mistakes were made the system detects discrepancies and reports about issues

U5.3. The user is able to cancel the last performed actions

U5.4. The system ensures the security of confidential information and intellectual property

U6. Consistency

U6.1. The user is able to predict the result of performed actions

U6.2. The system helps user to evaluate the influence of past actions to present state

U6.3. The user can easily apply his knowledge and experience from other systems

U6.4. It easy for the user to apply acquired knowledge and experience in other systems

U6.5. The system allows performing more than one task at the same time

U7. Interface

U7.1. The system ensures simple learning of interface usage

U7.2. Interface predicts user requirements

U7.3. Interface is always visible

U7.4. Interface is comprehensible

U7.5. The system provides shortcuts

U7.6. The system provides tools for account management

The list of usability and sociability heuristics from literature review is mapped with virtual world user needs (see Table 1.). The mapping shows that all of these heuristics are critically important for online collaboration and communication tools and implements user needs. However the mapping shows that some user needs are only partially covered by usability heuristics.

Table 1. Mapping user needs and usability heuristic

User need	**Usability heuristic**
Create virtual content and manipulate virtual objects	none
Protection of person and user content	U5.4
Ability to use the tool	U2.3, U2.4.
Safe and trusted system	U5.1, U5.2, U5.3, U5.4.
Multiple interfaces with the tools of messaging, maps, inventory, avatar movement control, search, object editor, etc.	none
Scalable screen view according to user hardware capabilities	U2.1, U2.2, U7.2
A basic set of rules is applied to virtual world content. The rules define licensing, protection of intellectual property and object creation and modification.	U5.4, S3.1, S.3.2
Interaction between avatars is analogous to people interaction in the real world	none
Various kinds of communication between avatars	none
Search for all kinds of content	U3.1
Extending the functionality of the virtual world using given tools	none
Movement in the virtual world is simple and intuitive	U1.1, U1.2, U1.5
Creation and modification of avatar	U7.6

The result of this analysis proved that user needs are partially covered by the usability heuristics. The usability heuristics designed for Web 2.0 applications should be modified and augmented in order to apply them to three-dimensional virtual worlds. Moreover, taking into account the results, the areas require a deeper analysis of the specificity of virtual worlds. The specific features regard avatars, virtual content and object interaction.

6 Usability Heuristics Derived from the Existing Virtual World Forums

We have made a survey of three virtual worlds' forums: "Second Life"[2], "Active Worlds"[3] and "There"[4]. The purpose of the survey was to ascertain if the virtual worlds meet usability aspects. First, we have

[2] http://forums.secondlife.com
[3] http://forums.activeworlds.com
[4] http://forums.prod.there.com

selected the following keywords: ‘usability’, ‘usability problems’, ‘navigation’ and ‘interface’. Second, we have detected the discussion threads which are related to the selected keywords. Third, search ended with tens of useful forum posts. The forums are surveyed further in this section.

The most frequently mentioned subject in Second Life and There is related to inventory management. Users claim that their inventory has a lot of objects and there is no a proper way of finding anything in it. Thus reorganizing the inventory wastes much effort. Forum visitors also suggest that any object attached to the avatar should have an icon indicating that. We think that the following heuristics can support the evaluator who wants to detect inventory assets management problems. The evaluator has to make a judgement if the following statements (heuristics) are true:

U3.7. Avatar inventory provides the means for searching, filtering and sorting

U3.8. An adequate system response is provided while attaching objects to an inventory asset

One more complaint was about decreasing available screen space in Second Life because of lots of new interface elements. The reason is that developers constantly improve the virtual world. Therefore less and less space for actually seeing the world remains. As one can notice, the decreased available screen space is similar to a Web page design problem. Here a well known recommendation states that informational part should occupy at least half of the whole screen. A special user testing is required in order to estimate more exactly. As a result we formulate the following statement (heuristic):

U7.7 The 3D screen space should be in the right balance with the interface space.

Active Worlds forum visitors discuss the ability to run multiple browsers concurrently. They claim that a frequent user needs to be inside several universes at one moment. As Active Worlds does not support this feature at present, the users spend significant time simply hopping between universes. This problem complies with the U6.5 usability heuristic.

Several observations were made on the buttons layout: the ‘Leave’ button is situated near ‘Activate’ and ‘Wear’ next to ‘Delete’. After trying to revise these discrepancies, we found that the problem was fixed.

Active Worlds forum visitors started the thread named “Critical flaws with Second Life”. This thread is intended to compare Active Worlds to Second Life and evaluate the critical disadvantages of Second Life. A confusing building activity was mentioned as a dominant usability problem. The users claim that building a virtual object in Second Life is not as easy as in Active Worlds. Here it is enough to drag the nearest objects and immediately starting to build. In Second Life, the user needs to learn the building primitives such as curves and shapes. This observation conforms to the U6.4 usability heuristic.

Second Life users are not satisfied with the time which is needed to get a basic experience to start even simple tasks. It is said that 4 to 20 hours is needed, which is enormous time range. According to forum visitors, helpful web pages for user guidance in Second Life are often hard to find. This issue extends the learning time. This problem is referred in the U7.1usability heuristic.

Most of virtual worlds provide the feature of group creation. This is useful for users who have common interests and organize teamwork between the remote members. However, Second Life users claim that the group management tool functions not properly. For example, after removing a member from the group it is not possible to prevent him from rejoining unless the group is invite-only. This problem is covered by the S3.2 sociability heuristic.

Several posts related to virtual world integration with various external systems have been selected. Forum visitors suggest a useful additional feature – to join virtual world from an external social network. Integration with social networks would allow importing friends from social networks, inviting them via their social network and providing invited friends with avatars or other virtual content. Thus, after entering the virtual world a novice could communicate with existing friends. This feature would help to conform to virtual world’s life easier and faster. This problem is summarized in the following heuristic:

U8. The system supports account transfer from external social networks and virtual worlds.

7 Conclusions

This paper presents a view of virtual worlds from a developer perspective. Developing a new virtual world is important to learn from existing and competing products. We analyzed experience gained from existing social collaboration and communication environments, primarily Web 2.0 tools.

Virtual worlds are devoted to provide playful experiences. Therefore, a purpose is to protect user from frustration when the user encounters usability defects. The most amusing feeling begins to pall the user after several annoying defects.

User forums are a useful source of information for usability researchers. The amount of information contained there is really huge. However, user forums form a unique archive of comments and complaints that cannot be obtained in another way. Apart from the collaboration and communication features, Web 2.0 environments are a source of valuable data for usability researchers.

The mapping of user needs onto Web 2.0 usability heuristics showed that the heuristics partially cover virtual world user needs. The analysis of user comments from popular virtual worlds' forums enables us to formulate additional heuristics. The full set will support the heuristic evaluation of the first beta version of VirtualLife platform.

The developed set contains 10 groups of aspects with their operationalizations. The forthcoming evaluations will provide a further material for the improvement of heuristics.

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