Virtual Context Based Services for Support of Interaction in Virtual Worlds

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ABSTRACT

A wide variety of virtual worlds exists today. They embed the user into a virtual reality allowing interaction with the virtual environment and, in case of multiplayer worlds, other users. Our goal is to support these interactions. Therefore we are using virtual parameters to describe the user's virtual context and provide additional services depending on this context. These services can either be included into the virtual world or can be realized using a community portal. In this paper we will introduce the concept of virtual context based services and its fundamentals like the classification of interaction in virtual worlds, a generic interaction model and an extended model including additional services.

Categories and Subject Descriptors

H.4 [**Information Systems Applications**]: Miscellaneous; K.8 [**Computing Milieux**]: Personal Computing

General Terms

Theory

Keywords

online games, MMORPG, context-based service, user-support

1. INTRODUCTION

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The success of Multiplayer Online Games (MOG's), as an example of virtual worlds, heavily depends on additional services and tools and the possibility to customize the game interface and to develop own features. Additionally this is a very important aspect for the growth of user communities since it arrogates and binds the members of the user community. Different kinds of game services exist. For instance services providing specific information to the user (e.g. a compass or map) or services for supporting communication and cooperation of users (e.g. for group building or trading). In most cases the community knows best the needs and drawbacks which can be met by additional services.

When a MOG is released, the developers provide only a starting set of such services and extend them from time to time. However, as the community grows, the demand for additional more extended or more immersive services grows. This demand is often covered by the community itself. But this community driven services often do not take so called ingame context parameters into account. Using ingame context parameters in a service significantly improves the value of the service and its possibility to support the user because it can be integrated better into the game. Although some developers provide APIs for such context parameters, a conception of ingame or virtual context parameters is still missing. This paper tries to fill this gap.

Thus we chose the Massively Multiplayer Online Worlds to start from (section 2). In section 3 the interaction in virtual worlds in general is analysed and classified. In section 4 we propose a generic model for interaction opportunities and corresponding services that could be provided to the users of those worlds. At the end of section 4 we present example services. Finally we conclude this article and give a short outlook on future work.

2. MMORPGS AS SPECIFIC KIND OF VIRTUAL WORLDS

Virtual worlds in general are simulated environments which

obey to certain rules and principles. Especially the virtual multiplayer online worlds, which allow a big quantity of users to participate and cooperatively work on tasks, are a very interesting scenario, because of the multiple possibilities for interaction and cooperation of users. The most common types of those virtual multiplayer worlds today are the Massively Multiplayer Online Games (MMOGs) and for our focus the Massively Multiplayer Online RolePlaying Games (MMORPGs), like World of Warcraft [8] or Guild Wars [3]. MMORPGs have heavily increased in number of users, distribution and importance over the last 10 years and they are still growing (see [5]). This boom was mainly driven by the game World of Warcraft by Blizzard [1] which by itself has passed the 8 million users count in January 2007. Especially in 2007 the computer game market will be heavily influenced by the release of various MMORPGs (e.g. The Lord of the Rings online [4], Warhammer Online [7], etc.). Thus we will focus our work on virtual worlds like they are used in MMORPGs. Nevertheless we will always try to make abstractions as general as possible to cover all kinds of existing virtual worlds.

The worlds in MMORPGs are simulated realities including physical rules like gravitation and other principles of the real world but mostly are based on a fantasy or science fiction scenario. No common definition of those worlds exists (see [9], [16], [15], e.g.) but there are some typical characteristics which can be found. For us there are three main characteristics which are of importance for our work: the **virtual character**, the wide variety of **interaction** possibilities and the **community**.

First there is the **virtual character** which is the main interface for the user to enter the virtual world. This interface is quite intuitive and therefore the entrance hurdle for new users is very low. Also the user can configure his virtual character after his own likings. Thus, beginning with the creation of his virtual character, the user is able to put a bit of his own personality into it. Entering the virtual world with his own character creates a special atmosphere for the user because he can see his creation involved in the virtual environment and such an immersive scenario emerges. Secondly the user has a wide variety of **interactions** he can perform with the virtual world and the non player characters (NPC's) but also with the virtual characters of other users. The third point is that most of these games encourage the interaction and cooperation of the users among each other and the development of **communities**.

For our research in supporting the users in virtual worlds, the interactions, which are performed regarding to the virtual world, are a key aspect. Therefore, the following section will go into more detail about interaction in virtual worlds.

3. A MODEL OF INTERACTION IN VIRTUAL WORLDS

In this section we will investigate which kinds of interfaces and interactions, subject to the interfaces, exist in usual virtual worlds and how they can be classified. Not all possible interactions are available to the user in each situation. Therefore we illustrate different classes of parameters describing a virtual and real user context. These parameters limit the possible interactions and affect the user's choice. Our investigations are resumed in form of a generic model of interactions in virtual worlds finally. This model is also the base for the support of interaction in virtual worlds by additional virtual context dependent services, which will be introduced in section 4.

3.1 Interfaces and Interaction in Virtual Worlds

Depending on the different interfaces provided to the user, different kinds of interactions are available in a virtual world. They vary depending on the considered user interface. The interactions can be described and categorized by properties. We have investigated the different interfaces that are provided and defined properties to categorize the interactions which are possible by using those interfaces. To understand how an interaction is chosen out of all possible interaction opportunities and what are the influence factors leading to the interaction, finally performed by the user, provides information that can be used for supporting the interactions accordingly.

The user interface enables the user to take some action either in the virtual world or in another virtual space which is connected with it (e.g. a voice chat). The most common interfaces are the **virtual character**, **chat** (text and/or voice) and the abstract interface **community**. In the virtual worlds we consider here the main user interface is the **virtual character**. With his character the user interacts in and with the virtual world and with the virtual characters of other users. With a **chat** tool (most worlds do have a text chat included) the user can interact directly with one or more other users via text. There are also additional tools, especially for voice communication, available which can be used beside the virtual world and which are widely spread among the users (e.g. TeamSpeak 2 [6]). Within the **community** the user interacts with many other users of the virtual world, but basically outside of it using special community portals (e.g. buffed.de [2]).

Different properties can be used to categorize the interactions enabled through the user interfaces. We have analysed the possible interactions and found four properties to describe them: the *interaction procedure*, the *interaction place*, the *interaction partner* and the *interaction type*.

- The *interaction procedure* determines the timing of the interaction. In a "synchronous" interaction the user has an immediate contact to his interaction partner which can be a virtual object or another user. For an "asynchronous" interaction the interaction partners make use of a platform so the interaction partners don't have to access it simultaneously (e.g. a forum).

- The *place of interaction* states where the interaction takes place virtually. If the interaction is done inside the virtual world we call it "ingame". Interactions connected to the virtual world or related to it but taking place outside of it we call "outgame".

- The *interaction partner* describes with whom the user interacts. An interaction can be performed with the virtual world itself (virtual things or NPCs). In this case the interaction partner is "virtual". If there is another human involved even through his virtual character, i.e. another user is my counterpart, we say the interaction partner is "real".

- We have mainly two different *types of interaction*. The first one is an "action in the virtual world". That

means we are doing an activity with our virtual character (e.g. we are walking through the virtual world or we are opening a chest). The second one is "communication" which means interaction through language (written or spoken). There is an "extended communication" also but we will explain this concept later.

We will now go into detail about how interaction can be categorized using the different interaction interfaces and interaction properties (see Figure 1). For each interface the possible interactions are analysed and categorized using the defined properties. For example the first row shows the values for the interface **virtual character** interacting with things of the virtual world. In this case the interaction is always synchronous, it can only be performed ingame, the interaction partner is virtual and it is an "action in the virtual world" regarding our definition. For each interface the values of the different properties are given. The table includes only the base functionalities of the interfaces and describes the interactions accordingly. Additional services are not considered here, because they are game dependent.

Interaction	Procedure: Synchronous / Asynchronous	Place: Ingame / Outgame	Partner: Virtual / Real	Type: Action itvw / Communication / (Extended Com.)
Interface: character interacting with virtual things and npc's	S	I	V	A
Interface: character interacting with virtual characters	S	I	R	A / C
Interface: text chat	S	I / (O)	R	C
Interface: voice chat	S	(I) / O	R	C
Interface: community	(S) / A	O	R	C / EC

Figure 1: Interaction: Interfaces and Properties

The third type of interaction we mentioned above is the extended communication. Extended communication includes the exchange of user created content about the virtual world. This is some kind of communication but not in a classical sense. Examples are the creation of guide lines about the virtual world or the making of movies using screen capturing of ingame activities. This extended communication is not focus of this paper but part of the concept of interaction regarding virtual worlds.

Based on this classification we are now able to investigate the interaction in virtual worlds in more detail. Especially we want to figure out the complete set of interactions in virtual worlds (interaction opportunities) and how they are limited by context.

3.2 Interaction Opportunities and Context in Virtual Worlds

The set of all interactions a user can perform in principle, depending on his interfaces and his type of character, we call *interaction opportunities*. To take a closer look at these opportunities and the factors, described by parameters, which influence the interaction actually performed by the user, we will start with those interactions we defined as "action in the virtual world". This means, the **virtual character** is the only considered user interface. To use a virtual character it has to be created first. The creation process depends on the virtual world. Normally it includes choosing a certain race out of a given collection, selecting a base or main category for the character and the personalisation of this character by configuring status and appearance values. Now it is possible to enter the virtual world with the created character. This new character possesses basic skills for interacting within the virtual world. We call these skills "inherent skills". They normally include skills for moving around in the virtual environment, for contacting and talking with other characters, for using virtual objects and for performing challenges (commonly called quests). Typically, the virtual character can improve by receiving experience points for what he has done. So after a while it will be possible for him to learn advanced or new skills and to go for a specialisation in a certain field. These skills will be called "acquired skills". With his inherent and acquired skills the character possesses *principle action opportunities* he can perform in the virtual world (see Figure 2).

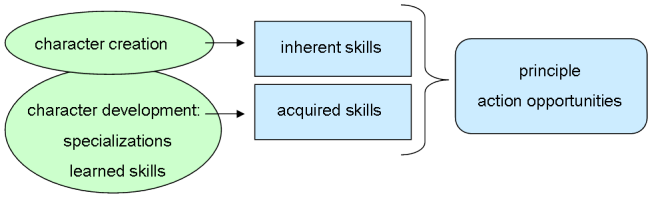

Figure 2: Principle Action Opportunities

This set of opportunities can not be performed anytime and anywhere in the virtual world, even if the user has the necessary skills. There are different kinds of restrictions, e.g. to use a swimming skill there must be water which is deep enough. Which of these skills can be performed in a certain situation and which of them will be performed depends on influence factors. These influence factors are composed of **virtual** and **real parameters**.

The **virtual parameters** reflect the situation of the virtual character and the virtual world. Examples of virtual parameters are the *location* of the virtual character in the virtual world, the *status* of the character, his *equipment*, the *time* and *state* of the virtual world and so on. Some of these parameters depend again on the skills of the character or on his experiences and history. In the following we will give some examples of selected virtual parameters. The list is not exhaustive but includes standard parameters which can be found in almost every virtual world:

- The *location* of the virtual character includes his coordinates, the properties of his surrounding, his field of view, etc.
- The *status* of the virtual character includes if he is a member of a team, group, guild, fellowship or other collective, his role (e.g. if he is team leader of a group), etc.
- The *equipment* of the virtual character includes his gear, outfit, items, content of his bags, etc.
- The *authorizations* and *functions* of the virtual character are based on his skills (what he can do) and on his history (what he has done). For example the ability to ride a fast horse may depend on learning a riding

skill first and then to master this skill by practising with a slow horse to be able to handle the fast one.

In addition to these virtual parameters there are **real parameters**. The real parameters cover those aspects of the user, which influence the interaction he performs in the virtual world. Examples for real parameters are *availability* (is the user away from keyboard, how fast is his internet connection or how much time does he spend in the virtual world - maybe he has appointments in real life, and so on) *experience* of the user (with the actual virtual world and with similar ones), *goal* of the user (what is he going to do, what does he want to achieve) and the *likings* of the user.

3.3 The Generic Model of Interaction

Based on the methodical investigation about the interaction opportunities in virtual worlds and virtual and real parameters we developed a generic model of context influenced interactions in virtual worlds. Therefore we analyzed all the different interaction types regarding their similarities and differences of interaction opportunities and parameters as explained above. We started by developing an interaction model for "action in the virtual world" and an interaction model for "communication".

3.3.1 Action in the Virtual World

The model regarding the "action in virtual worlds" (Figure 3) includes the *principle action opportunities* introduced above (see Figure 2). Additionally the influence of the design of the virtual world on the actions a character can perform is shown (*rules of the virtual world* on the left side of the model). On the right side it is shown how the set of actions is reduced by the **virtual parameters** (e.g. location, status and equipment). The virtual parameters describe the *virtual situation* of the character (we call it the *virtual context*).

Depending on the virtual situation a subset of actions which can be performed in the actual situation is generated (*actual action opportunities*). A simple example is that the character has the skill to open chests. Now he wants to open a chest but this chest is locked. Even though he has the skill to open chests he will not be able to open this one without using the right key to unlock it first or break the lock.

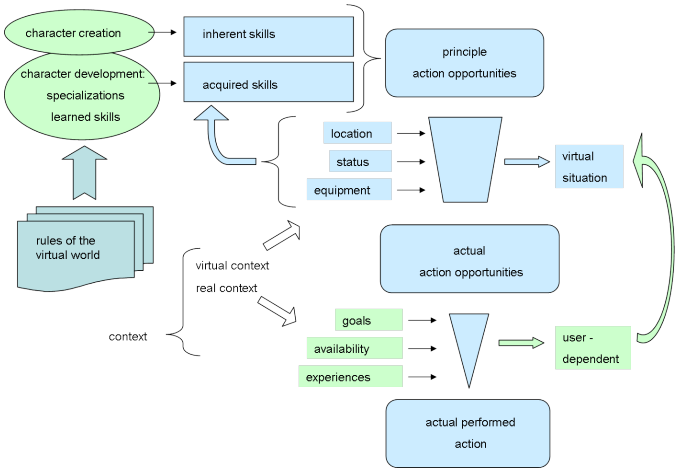

Figure 3: Interaction: "Action in the Virtual World"

Out of this subset, the action, which is actually performed (*actual performed action*), is determined by the user. The user chooses the action he is doing regarding to his goals, experiences, likings and so on. These **real parameters** are the context in which it is decided what possible action is executed. Again we will show this with the simple chest example. Assume the user has both, the right key to unlock the chest and the ability to break the lock. If his goal is to increase his lock-breaking skill then he will not use the key. But maybe this is not his goal but he knows that to break the look will take much more time then to open it with the key he already possesses, then he will use the key and unlock the chest in order to open it.

To complete the model, the arrow from the **virtual parameters** to the "acquired skills" indicates the influence of these parameters on the character development (like as explained for the virtual parameters *authorization* and *function*). And the arrow from *user-dependent* to the *virtual situation* shows the influence of the user (the real parameters) on the virtual situation (e.g. if a user does not want to do something he will avoid certain virtual situations and so on).

To summarize, in two steps, out of the set of action opportunities the user has through its character, one action is selected and performed only at a time. This action depends on the virtual context which reduces the action opportunities to a subset of possible actions and on the real context which is responsible for the selection of the action the user actually performs.

3.3.2 Communication

A quite analogous model can be developed for interactions of the type "communication". For communication not only one interface but different ones have to be considered. In a typical game scenario we have two ingame interfaces for communication the **virtual character** and a **text chat** as well as one outgame interface for **voice chat**. The character enables "immediate communication" between virtual characters and the chat interfaces enable "directed" or "specific communication". With the ingame interfaces the *ingame communication opportunities* are defined (see Figure 4).

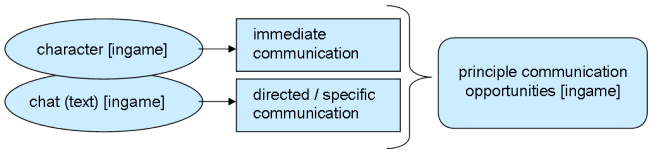

Figure 4: Principle Communication Opportunities (ingame)

The **virtual parameters** are again responsible for the subset of communication opportunities which can actually be performed in the current situation. For example the character can say something which will be shown in a speech bubble above his head. All the characters which are located nearby will see that he has spoken something but only for those who belong to the same fraction the displayed text will be readable. Maybe the character will have to wave instead of saying hello so that another character form a different fraction will understand his greeting. Like in the action scenario described above a subset of *actual ingame communication opportunities* emerges. Additionally the *actual out-*

game communication opportunities are added to this subset. The communication which is then chosen by the user again depends on the **real parameters**. He will pick the communication which is most appropriate regarding his goals, experiences, likings and so on.

3.3.3 *Generic Two-tier Model of Interaction Opportunities*

The essence of those two models is a generic two-tier model (see Figure 5).

Generalised it can be said, that in the first step the interaction opportunities which are available in principle are reduced by the virtual situation (the virtual context). The virtual parameters determine whether an interaction can be performed in the current situation or not. On this account, a subset of interaction opportunities is generated representing those interactions which can be performed actually.

In the second step, the interaction that is actually selected and performed, results on behalf of the user and his situation (user-dependent). It is determined out of the possible interaction opportunities which are actually available (the interaction subset which was the result of the first step). The chosen interaction depends on the real parameters, they build the real context.

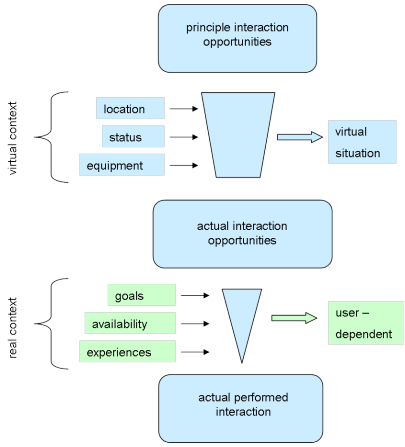

Figure 5: Generic Two-tier Model for Interaction in Virtual Worlds

In addition to the interaction opportunities, given by the different interfaces introduced above, most virtual worlds include some services. They offer additional functionalities like to provide specific information to the user or to assist the user. There are services which can help the user for example to orientate or navigate in the virtual world (e.g. a compass or mini-map). There are also services assisting the cooperation of different users (e.g. a group-finding tool, a special marketplace for trading or an auction house). Some virtual worlds provide API's to include user developed services (add-ons) into the virtual world. But the provided interfaces differ a lot in functionality, usage and the possibility to base them on a limited set of virtual parameters.

4. VIRTUAL CONTEXT BASED PROVISION AND CONTROL OF SERVICES

Context based services can be provided either based on the *virtual situation* or *user dependent*. That means, services can be controlled and provided depending on the virtual context and the service usage can be assisted depending on the real context. Using real context parameters, for example collected through sensor networks, is already focus of ongoing research work and commonly named as context-aware services. It is used for example in real communication scenarios [11]. Further related work of context aware applications are e.g. ubiquitous computing systems [12], [10], computing applications [13] or communication applications [14]. For extended or additional services which are based on the virtual situation no generic related work could be found. But this is in fact a very interesting and important aspect, too. It is a more abstract view and can be used for any kind of virtual world which exists today. See Figure 6 for the extended interaction model including context based service.

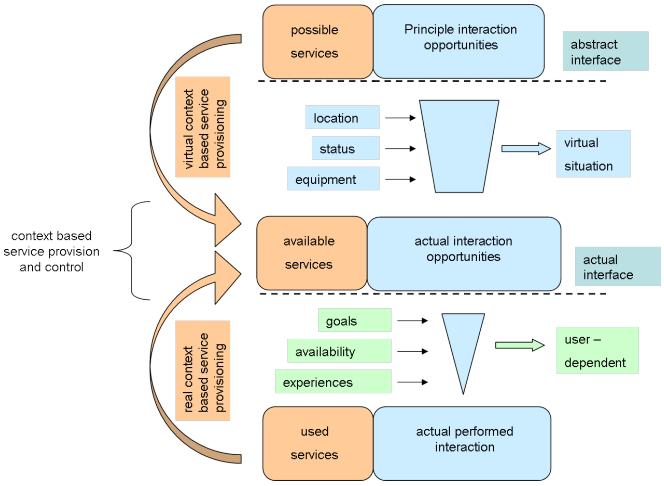

Figure 6: Interaction and Services

Every layer of the Interaction model can be connected to the corresponding service level. The *principle interaction opportunities* are related to the **possible services** which can be provided in this scenario. On the next level the *actual interaction opportunities* correspond with the actual useful or actual **available services** in the same way. So the determination which services should be provided depends on the *virtual situation*. The same observation can be made when looking at the bottom part of the model. The **used services** are also related to the *actual performed interactions* and which services are used depends on the user and his context accordingly (*user-dependent*). The services are an extension to the interface. They can provide additional information or functionalities or they can be used to present information in a different way which is more useful or intuitive for the user.

Analysing the virtual context and using this information is the focus of our work. One simple example how this concept can be used is a virtual context based voice communication service. This service can include one or multiple virtual parameters to control and provide an appropriate communication between the different participants. Possible parameters which can be used in a virtual context based communication service are for example:

- Location-based (*location*):
  - Participants in a certain area share a channel

  - Participants in earshot share a channel

- Group-based (*status*):
  - Participants in the same group share a channel
  - Hierarchical groups (sub-groups with sub-team leaders): Participants using different channels simultaneously depending on their role and status
- Experience-based (*experience*):
  - Participants with similar experiences share a channel
- Communicator (*equipment*):
  - Special items enable communication

A communication service based on virtual context parameters can use these parameters for service provision and service control. For example the communication service is provided if the virtual context parameters match: if a user joins a group he will be added automatically to the appropriate communication channel. And the communication service is controlled depending on the virtual context parameters: if the user is the leader of the group he will be able to give orders to single members or sub teams or announce important information to the whole group without being interrupted.

5. CONCLUSIONS

Virtual worlds are virtual spaces built according to the real world but with their own rules and principles. The virtual worlds can be attended through the user interfaces which open an entrance to these worlds and enable the user to perform interactions. The different interactions can be performed by taking "actions in the virtual world" or by "communication" either with the virtual world or with the other users of it.

To support interaction in virtual worlds it is necessary to build up on their foundations and basic concepts. Thus it is possible to develop a generic model and propose context based services. The analysed principles we described here are a foundation of our work. We have defined parameters to describe virtual and real context and developed a generic interaction model. The interaction model is the basis for including additional and extended services for the support of interaction and cooperation of users. These kind of services enable a new perspective for user support and can be used in different application scenarios. They provide the opportunity to apply immersive services, which are integrated in the flow of the game to enable a rich and enthralling gaming experience.

Our research work includes the analysis and description of virtual worlds. The support of interaction and cooperation of the users and communities of those worlds are an emphasis of our work. Our main focus lies on MOG's, but we are also trying to work on an abstract level and transfer the concepts to other domains. We have started to build services based on the developed interaction model to verify our concepts. These services include game comprehensive and game specialised services. Game comprehensive services allow game independent solutions, but they are restricted through the inaccessibility of ingame information in many games. For game specialized services it is possible to fully make use of the options some games offer by providing an open API to gather ingame information and extract virtual parameters. We are also defining interface extension descriptions to offer a generic service interface and to minimize the transmission overhead for services. For the implementation of our concepts we are currently working on a services providing system to cover the entire value of additional services in ingame and outgame applications.

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