Undercurrents
A Computer-Based Gameplay Tool to Support Tabletop Roleplaying

Karl Bergström[12]

[1]Game Studio

The Interactive Institute

SE-164 26 Kista SWEDEN

karlb@tii.se

Staffan Jonsson[1]

staffanj@tii.se

Staffan Björk[12]

[2]Department of CS&E

Gothenburg University

SE-412 96 Göteborg SWEDEN

staffan.bjork@chalmers.se

ABSTRACT

This paper introduces Undercurrents, a computer-based gameplay tool for providing additional communication and media streams during tabletop roleplaying sessions. Based upon a client-server architecture, the system is intended to unobtrusively support secret communication, timing of audio and visual presentations to game events, and real-time documentation of the game session. Potential end users have been involved in the development and the paper provides details on the full design process.

KEYWORDS

Computer-Supported Gameplay Tools, Computer-Supported Collaborative Play, Role Playing, Tabletop Role Playing

INTRODUCTION

People have played games in all ages and places. Computer-based games, currently being played in 68% of all American households and having players with an average age of 35 and of which 40% are women [14], have clearly become an increasingly important entertainment form in industrialized societies. Looking at the computer games available as a whole, they offer people a wide selection of challenge types ranging from casual (e.g. Minesweeper [22] and Spider Solitaire [51]) to formalized competitions (e.g. Counterstrike [33] and Starcraft [39]); they allow people to play alone (Fahrenheit [9], Curse of Monkey Island [1]) or together (Civilization [28], Wii sports [43]); they allow people to switch between gaming, socializing, creating and other activities while still acting within the boundaries of the games. This variety is probably one reason for the success of computer games; there are games that suit most types of people and types of situations.

Given this, one can wonder if any other types of games can compete. Clearly they can, since even those with easy access to computer games buy and play other games. One reason is probably that interacting with computer games focuses players' attention on the display, which isolates them from their surroundings. This may be of little consequence for single-player activities or when playing with people spatially removed from each other, such as over the Internet, but it does limit face-to-face interaction with people in their immediate

vicinity. Another issue is that the computer in many cases dictates the pacing of the gaming experience, making it difficult to negotiate common pauses or changes of activity in multiplayer games. A third issue is that the rules of the game are fixed by the computer code and it is very rare that it is possible to change or ignore these during gameplay, which for example makes it difficult to let novice players remake moves, set up examples or modify the rules to fit the player group.

All these aspects of computer games seldom occur in traditional card games, board games and role playing games (RPGs). The gameplay these games provide can be modified to fit various social context; they can be said to have Social Adaptability [16], thereby offering players additional facets of the gaming experience. Having a computer application facilitate a game could help keep track of game states and statistics, enables private communication channels and makes it possible to present video and audio material to players. That these possibilities, and those of playing against computer opponents or people in other places, are interesting to those playing traditional games is evident from the fact that many traditional games have computer-based versions. But is it possible for traditional games to gain these advantages of computers without losing their social adaptability, and thereby significantly narrowing the range of social contexts in which the games can be played?

This paper introduces *Undercurrents*, a computer-based gameplay tool which provides computer-support to traditional RPGs while not requiring its constant use. The system allows players and game masters to have alternative communication and media streams during game sessions and to document their activities while playing. An overview of RPGs and previous work is provided, followed with a pre-study in which user requirements were gathered and a description of the conceptual development. The Undercurrents system is then presented continued with reports of initial user feedback. The paper concludes with proposed future work and reflections upon the computer-based gameplay tools concept.

BACKGROUND AND RELATED WORK

Undercurrents has been developed as a tool to support traditional tabletop role playing, making tabletop roleplaying and other supporting tools relevant background areas. However, the following sections also covers computer role playing systems and various types of games that have been computer-augmented in order to later be able to contrast their purpose and functionality with those of Undercurrents.

Role Playing

Many different phenomena are described by the term "role playing", but a closer look reveals that they are only peripherally connected, with not even actual role playing as a common factor [56]. Tabletop role playing (also known as pen-and-paper or PnP role playing) grew out of wargames in the seventies [18][23] with the most well-known probably being Dungeons & Dragons. One important design change from wargames was a shift in focus from controlling many units from the perspective of an intangible overseeing leader to controlling one unit from that unit's perspective, or in other words "you put yourself into your character's shoes and make decisions as if you were that character." [23] Another change was the emphasis on one person, the game master (GM), facilitating the game world and the narration to the players.

The idea that a player should talk as his or her character while playing quickly sparked the idea that one should act out all the character's actions as well and led to the development of live-action role playing (LARP) [30]. In this type of role playing people dress up as their characters and participate in secluded events, sometimes lasting several days. Since players move around more in LARP games, complex rule sets and GMing is less practical, but these games can generally support many more players, sometimes in the hundreds.

The invention of computer games came not long after the invention of the computer, and in many cases computer games have been adaptations of existing games or clearly inspired by them - one of the first computer games was a version of Tic-Tac-Toe called OXO [12], and Tetris [44] was inspired by the board game Pentominoes. The advent of RPGs in the late 1970s has been especially influential on computer games. Not only did they inspire computer role playing games (CRPGs) including the Ultima [20] series, the Fallout series [17], and the Elder Scrolls series [15], but they also influenced adventure games (e.g. the Zork series [58]), real-time strategy games (e.g. the Warcraft series [59]), and massively multiplayer games (e.g. Ultima Online [57] and World of Warcraft [62]). For many CRPGs this is especially apparent since they willingly adopt the rules sets wholly or in part from their tabletop counterparts or are required to do so by license agreements (see [3] for the history of CPRGs). These computer games remove the need of GMs and book keeping of character progression while with few exceptions reducing them to single-player games (often letting the single player control a group of characters). Indeed, CRPGs have been characterized as needing randomness and formal promotional systems while social interaction lies more in the domains of multi-user dungeons (MUDs) and massively multiplayer RPGs (MMORPGs) [3].

In order to avoid unnecessarily designing out certain types of tabletop role playing an inclusive stance on roleplaying was taken under the development of Undercurrents. For this reason, roleplaying is viewed as "making decisions based upon a character's goals" (a refinement of a definition found in [7]) for the scope of this paper.

Computer-Supported Roleplaying

Computer RPGs are designed to mediate the whole role playing experience through the computer. This solution is not ideal to all types of players given the assumption that some would prefer the face-to-face social characteristics of tabletop roleplaying. Wanting to address this, the Stars [36] and the TViews Table Role-Playing Game [38] use interactive tabletops that embed support for rule mechanics. They both are designed to be able to make use of PDAs and provide ambient sound output for the specific games implemented on them. Trans-Reality Role-Playing Games [35] have been proposed as a combination of tabletop, live action, and computer roleplaying games to form a single game form.

Although the focus of this paper is on face-to-face role playing activities, the use of computers in other game contexts is relevant to provide comparisons of how technology can be used. Looking at the most similar game contexts, there are several examples of how to augment traditional types of games. Focusing on card games, the TARBoard [34] makes use of cameras tracking markers to provide a tangible augmented reality game. False Prophets [37] make use of handheld computers and an interactive board to create a hybrid board/video games with the explicit design goals of supporting face-to-face social interaction. Wizard's Apprentice [46] uses cards, figurines, and a die as the sole input device for computer-controlled multiplayer board game. Prosopopeia [26] and Momentum [27] show how live-action role playing games can be computer-supported through the use of web-based applications and custom-built devices.

Looking at the related area of sports, PingPongPlus [24] augments ping-pong tables and provide the first reference to the idea of Computer-Supported Cooperative Play. Exertion Interfaces [41] show how video projections of remote location can be augmented with sensors and overlays to provide various sport-based activities while trying to maintain the social context of face-to-face interaction. The EU-project Together Anywhere, Together Anytime [54] explores how gaming and other leisure activities can facilitate mediated social interaction to promote togetherness.

It should also be mentioned that making use of the social face-to-face interaction has been introduced in computer games through the idea of ubiquitous or pervasive games (for an overview see [4]). Both MIND-WARPING [52] and Human Pacman [11] combine augmented reality and tangible interfaces to provide game experiences, in one case a "cross between a martial arts fighting game and an agent controller" and in the other a remake of Pacman played in a physical environment. Pirates! [6] and Songs of the North [32] forces players of PDA- or mobile phone-based game to walk in a physical environment and keep track of other players positions. REXplorer [2] is similar but provides historical information for tourists while playing. Klopfer et al. [31] uses augmented reality to create a game for learning requiring small group skills. The Backseat Playground [21] makes the environment passed during a car drive become part of a game world. Although all these examples may include face-to-face

interactions, they are not designed to do so continuously and the gameplay is mediated through the computers.

Computer-based Gameplay Tools

Although the examples given above do support face-to-face interaction they also contain vital aspects of the activity within the computer system. This either forces players to be restricted to the activities supported by code running on the system or reprogram the systems if they want to modify the activity or engage in an un-supported activity. One solution to this would be to consider computers and their applications as tools supporting the roleplaying activity rather than the basis for the activity. Instead of having rule interpretation and game state updates inside a computer system which players can access, the players control the rule interpretation and game state updates with support from computers. Thus, one could consider having computer-based gameplay tools that can be brought to an activity if it is suitable. Instead of being directly dependent on the tools for the activity, they can be added or removed as fits changes to the activity and the context in which it takes place. These computer-based gameplay tools would then be examples of Calm Technology [60] but without connotations that the tools are ubiquitously available.

There already exist some commercial examples of computer-based gameplay tools for tabletop role playing: the Campaign Cartographer 3 [10] and GURPS Character Assistant [53] help GMs create maps and characters respectively but are more likely to be used between play sessions than during them. The Dungeons & Dragons Insider service [13] gives tools to create characters, monsters, encounters, and look up game rules but is quite understandably dedicated to a particular game system and also geared towards supporting game preparations rather than actual gameplay. Numerous dice rolling application exist but are not likely to be advantageous over normal dice for tabletop roleplaying unless they are developed for mobile devices, such as the DiceDaemon [5] and MachDice [29] iPhone applications.

METHODOLOGY

The starting point for Undercurrents was to explore how the communications and media capabilities of computers could improve the tabletop role playing activity. However, tabletop role playing groups are quite small (compared to e.g. LARPs and MMORPGs), and many play in the same group for years. These groups quickly develop their own play style, frames of references, and own rule versions. Given that groups also play a wide variety of RPGs, ranging from products such as Call of Cthulhu [45] and World of Darkness [61] with specific settings through generic systems such as GURPS [25] to entirely homemade systems and settings, it seems that choosing a specific game would limit the exploration (unlike Stars [36] and TViews [38] which had interests in specific computer-based interaction techniques).

With the above in mind, grounding, and later confirming, design decisions for Undercurrents with actual players representing various ways of playing RPGs was deemed a high priority; it was decided to involve the potential future users, i.e. tabletop role players, from the onset. By thus following the standard practices from both game design and interaction design (e.g. [19][47][50]), these people could inform and influence the project at the concept stage and also later in testing and refining of the system. This approach also differs from that of Stars [36] and TViews [38], which although clearly have been designed by people knowledgeable of RPGs, have not documented how they included potential users in the design process.

Not having an invested interest in any specific technology or hardware, the design process of Undercurrents could start by openly exploring what wishes and needs future users had. The first task was thus: what features should a computer-based gameplay tool have in order to support tabletop role playing?

PRE-STUDY

The purpose of the pre-study was to develop the concept further and receive input on possible features to support. Three focus groups of tabletop GMs in two cities were recruited for one meeting each. GMs where chosen over "regular" players because these would likely be more experienced in the running of a game (for an in-depth explanation of the role of the GM, see [18] and [55]).

The target size of the groups where four people (excluding the researcher). The more formal, recorded section of the meetings took little more than an hour each, but in all cases some or all participants stayed for up to two hours longer, discussing ideas, role playing in general and GMing. The participants were all male ranging in ages between 16 and 45 and had GMed for between 1 to 20 years.

All meetings were structured in the same manner and began with presentations of the participants, the designer, the research institute and the project. The participants were asked to briefly describe their role playing and GMing experience, what kind of campaigns they were running and what kind of RPG systems they used. Another round followed with the participants sharing what experience they had with using computers during tabletop sessions, but also if they used other media such as soundtracks, images, maps and the like. To provide food for thought, the ideas of the designers and the ideas of earlier groups (if any) where then presented. Participants were asked to comment on the ideas regarding their usefulness, specific design requirements they would create, and which of the ideas were the most interesting. After this the participants were asked for their own ideas for computer support of a tabletop session. If they had the resources, what would they do? These ideas were also added to the discussion and ranked by the participants in order of usefulness.

Initially the plan was to start with the participants own ideas, but it quickly showed that they needed some firm ground to begin with in order to be able to come up with constructive contributions on their own. Thus the designers' own ideas might have had considerable influence on the participants. In any case the input from the participants was considerable and several new feature concepts where developed during the meetings. Listed below are the main feature ideas that

coalesced after the three meetings (with the one's considered most useful first):

- A repository for digital versions of the RPG books.
- A media-control centre supporting multiple playlists (e.g. "action" and "suspense") and sound effects.
- A hidden layer of communication to send messages to selected players.
- The capacity to keep a record of your character/campaign, a sort of journal keeping function.
- Rule support, e.g. rolling of dice, calculating damage, etc.
- Handling of digital props, e.g. maps, pictures and documents.

The participants were also asked to give input on the general design of the future system and what considerations the designers would have to keep in mind in order to appeal to tabletop role playing gamers:

- Simplicity above all – if "the hassle factor" was noticeable the system would not be used.
- Be distraction-free, letting players focus upon the gameplay.
- Setup time must be very low to not add additional time before the role playing session can start.
- Integrate itself as smooth as possible into the game experience – do not steal time or "flow"

The participants varied in their insistence on wireless and cordless units – for some it was an absolute must, for others merely a convenience.

It is also worth mentioning that the focus groups were surprisingly positive towards the idea of a computer-based gameplay tool when asked to evaluate its general feasibility.

CONCEPT DEVELOPMENT

After the pre-study the designers had a pretty clear picture of what features would be most interesting to implement. Taking resource limitations and available development time into account, the following feature wish list was identified:

- Messaging between the actors in the system
- Documentation support
- Media controller
- Document management
- Bookkeeping support

The possibility to send messages to specific players in the player group was the idea that sparked the project. Due to the nature of role playing, some game information is intended only for specific recipients (e.g. if only one character notices something in the game world then only that character's player should be informed). Most player groups use either hand-written notes or have unintended recipients cover their ears or briefly leave the room, each having its own set of shortcomings. With Undercurrents, GMs and players should be able to expediently transmit messages secretly between themselves. Given the medium, these messages can contain more text than written notes, not contain illegible handwriting (a surprisingly common problem according to the focus groups), and support a "messenger-style" mode of communication.

Integrating different forms of media into the game experience has been the dream of many GMs, but most come only as far as running a soundtrack in the background, perhaps switching between tracks now and then to support the current mood of the game. Few also use background images or slideshows being projected in the game area. In Undercurrents, users should be able to maintain multiple audio playlists and cross-fade between them, as well as insert sound effects into the audio stream.

Many GMs create documents, photographs, etc. that contains information about the game world, its characters and/or the specific scenario. These documents often contain vital clues or information the players might need during a game session. A way of managing these documents, sending them in a message and reviewing them later could potentially ease this process, although it is in the nature of many such "props" that they are physical rather than digital.

Implementing full computer support of an RPG system was discarded because of time limitations, issues of intellectual property and the necessary specialization of the system – it would not be able to support a variety of tabletop role playing, but rather one specific system. A general tool for bookkeeping support with which users themselves could create matrices for specific systems, is more appropriate for Undercurrents.

Documentation support was one of the features embraced wholeheartedly by the focus groups since very little of a typical tabletop role playing campaign is documented, despite often involving extensive note-taking. Besides nostalgic values, this is a problem if a player has missed sessions and needs to catch up, or if a new player joins the group. For this reason, player groups sometimes use wikis to document important events, characters and setting information as well as in game documents, images and/or other props; but this is generally done in-between sessions rather than during sessions. Undercurrents seeks to integrate wiki access into the system, so that the players can access all documented material during the session and update or add to it in real-time. Players will be able to go back and review what has happened before, even after the campaign is concluded, and have persistent access to the documentation if they wish to create outside of game sessions. Another important effect is that all saved notes are ordered and in the context of their game session. This allows players to go back and check things if need be.

In addition to the features mentioned above, the following design considerations were made, almost wholly based upon the wishes of the focus groups:

- The system needs to be simple and easy to set up in any environment as few player groups have a dedicated space for role playing activities.
- The interface must be "hassle-free", unobtrusive and rapid to use in order to preserve game flow.
- The units of the system must not restrict the players' movements or get in between the players, thereby hampering enactment during the session.
- The system must require as little as possible maintenance during a session.

Following a discussion in the design team all notions of internal privilege management in the system was rejected. Role playing is built on doing things together in trust and no reason was found to believe this social contract would not extend to the support system.

Mock-up Trial

Given the decisions regarding the concept, it was now possible to decide on a hardware platform. Eee 901 netbooks were selected for their small size, robust construction, and long battery life. The small form factor of the netbooks was believed to make it feasible for players to keep it in their laps or have several on one table. The robust construction was likewise seen as making it possible for players to put them aside on the floor if they want to get up and play in a more physical manner. Wishing to be able to prototype quickly, the full PC operating system of the netbooks were seen as an advantage and their full keyboards were viewed as the most efficient way for players and GMs to provide input. The extensive battery life of the devices would make it possible to use them unplugged for an entire game session.

Shortly after the acquisition of the hardware platform, a mockup trial was conducted using the said hardware but without the custom-made software. Instead, a simple web-based chat client was used, allowing the participants to simulate one of the features planned for the *Undercurrents* system. Three players (all male; 25-29 years old) took part in the mock-up trial as players, with the designer taking the role of GM. The scenario was a simple, largely improvised sci-fi drama featuring plenty of opportunities for hidden communication. The netbooks were all placed on a table which the players sat around on kitchen chairs. During the four hour session the alternative communications channel was used frequently by all players to send messages back and forth between themselves and the GM; it was somewhat of a surprise to the developers that there was not only significant player-GM communication but also player-player communication[1].

Afterwards the players were asked to evaluate the ideas and the hardware. They were generally positive and considered *Undercurrents* to be a novel, interesting idea. However, they also added that it probably was not for all groups and/or all scenarios; some might find the devices incompatible with a fantasy theme, some may simply be technophobic, and one-shot sessions do not need record keeping. They also emphasized the need for a dark, unobtrusive interface design not to disrupt the experience.

THE UNDERCURRENTS SYSTEM

The concept implied that the system would need to be very easy to set up and configure. Another requirement was persistent access to the system from the user's home environment and different gaming locations. This called for a client server solution where the client would be available or easy installable on any home computer and the server available via a normal internet connection. Based on these requirements we decided to implement *Undercurrents* as web-service accessible through a normal modern web-browser. This only requires the user to remember a URL and minimizes the setup time to opening the browser and entering a URL.

Based on the requirements, the time available, and the limitations of web applications, it was decided to focus on implementing feature 1 (messaging between actors) and 2 (documentation support). By selecting these two features the system could quickly be developed to look at two different usage situations and provide feedback for further development. The first use situation would be when preparing for a game session, or reviewing notes after one (using feature 2); the second use situation would be during game session for both messaging (feature 1) and for making and retrieving notes (feature 2). The use situations also differ in the former typically being a single-user case while the latter is a co-located multi-user case.

Using off-the-shelf applications, such as an IRC-chat and a wiki, in order to arrive at the desired result was considered, but rejected sine these could not be combined into a single interface, an important feature to make the sessions run as smoothly as possible.

Implementation

The messaging and documentation systems of *Undercurrents* were coded in Ruby on Rails [49] using RedCloth [48] to provide HTML formatting, and the real time parts were realized as a Ajax powered web application written in the MooTools java script framework [40]. All user information is stored in a MySQL database [42]. The system was developed to be modular ease future extensions and uses the Model-View-Controller pattern to provide flexibility in modifying the interface.

The messaging system was modeled on how passing paper notes during role playing works while the documentation system is a scratch-built wiki (the reason for not using an already existing wiki system was to have full control of how to implement access control to pages). Two different interfaces were developed for the different use situations, hereafter called *maintenance interface* and *in-game interface*. All in all, the system is quite small, consisting of 1026 lines of Ruby code and 502 lines of Ajax scripts.

The maintenance interface, which also functions as the lobby for the in-game interface, has a GUI much like a normal web application. Since GMs typically do the main part of preparing sessions, the system was designed to have the GM as the user administrator. As such, the GM can create game sessions, invite characters, and use a public wiki area to prepare information that will be publicly available for the players during sessions, e.g. to provide information about the setting that the players' characters would be aware of. A private wiki area allows the GM to create secret information. Players also have their own private wiki areas, which can be use to edit information about their characters and edit transcripts from previous play sessions.

---

[1] Some RPG scenarios are designed for this, but not the one used.

The maintenance interface does not contain a communication interface which can be surprising since it functions as a lobby, but since the players are co-located they can do the necessary coordination using normal conversation.
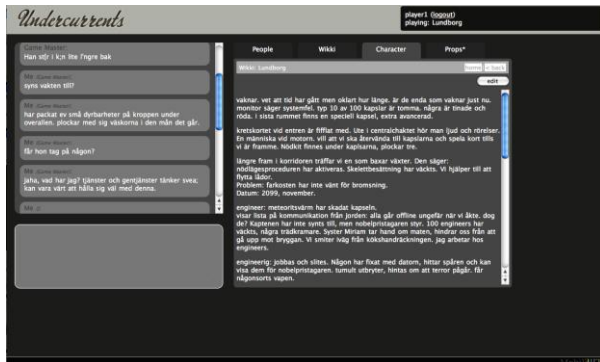

Figure 1. The in-game interface for *Undercurrents.*

The in-game interface of *Undercurrents* provides players and GMs with a selective messaging system and access to both the public wiki and their own wiki. Private wiki pages can be published by links in messages, and external sources (e.g. images or videos) can be linked to from both the messaging and wiki systems. To minimize potential distractions, the GUI uses dark hues, both to counter computer backlight (which might disturb the lighting conditions) and to minimize the GUI's potential to grab players' attentions. All important functions of the system are accessible with keyboard shortcuts to minimize disturbing moments like looking for the mouse pointer.

INITIAL USER FEEDBACK
With the first software prototype developed, a prototype trial was set up using the netbooks and the *Undercurrents* system. The actual gameplay use situation, i.e. a role playing session, was selected instead since this allowed one of the researchers to be GM (and thereby being able to mitigate possible technical problems) and, more importantly, allowed participatory observation of how the social interaction was affected by the system. Besides the GM, the group consisted of four players (3 males, 1 female; 19-33 years old). The participants were provided with dinner and soft drinks throughout the 5½ hour session.

Figure 2. Typical use situation of *Undercurrents,* with the game master (and one of the researchers) in the lower left.

The users accessed the system through the Firefox 3 browser in full screen mode to minimize distraction from other applications and web sources. The players used the system throughout the session to communicate secretly, mainly with the GM, but also made extensive use of the wiki in order to take notes during session, something which was unexpected since the scenario was not part of a larger campaign. Unlike the mock-up trial, players engaged mostly in player-GM communication and very little in player-player communication. This discrepancy between the mockup and prototype test groups was probably partly due to different play style but also partly due to differing levels of player experience.

Both after and during the session feedback was gathered from the players. Their wishes, which were mostly related to the interface, are summarized below:

- Highlight new messages– maybe through blinking icons
- Provide hotkeys for common messages – e.g. 'yes', 'no'
- Place sender and message on the same row
- Expand the 'people' tab to include descriptions of characters
- Make senders' name more visible
- Color coded messages
- Provide an 'open' notepad with automatic saving
- Enable received message notification
- Make messages sent to 'all' distinguishable from the rest
- Make own messages less visible than others
- Provide Access to the wiki also outside the game sessions
- Enable Configurable timestamp on messages
- Increase the width of the chat-window

The players expressed that they would like to test the system more in future sessions. Two of the players also said that they would have preferred their own, standard laptops over the netbooks; but that this probably was a question of familiarity with the small keyboard as well as personal preferences. Given the web-based system architecture using other computers is trivial (just input the URL in any modern browser) and shows that the users were unaware of the software architecture.

DISCUSSION
Undercurrents was developed to be a computer-based gameplay tool which supports tabletop role playing sessions with a minimum of disturbance to the social interaction; facilitating, rather than mediating, the game. The current prototype, although only providing two main areas of functionality, has received positive feedback from users without complaints about negative interference with the experience and adheres to the idea of calm technology.

Only one group was tested and might have expressed ephemeral positive views due to the novelty of the system or that the GMing researcher was known to be part of the development team. A more longitudinal study with several different groups is planned after the system's next iteration in order to properly study the documentation support features, something which was impossible during the shorter trials. This would also allow an evaluation of the maintenance interface, which so far has only been tested in its role as a lobby. These trials would also be independent from the designers to see if an

unassociated player group can learn the design and utilize the system with little or no outside help.

Looking at functionality, the integration of media controller is a logical next step since is a requested functionality that can be added as an independent module. The media controller is also interesting to explore from how the social interaction is affected since it will provide dynamic changes to the gaming environment under the GMs' control. It would also open up possibilities to test novel output formats such as digital photoframes or the Philips *Ambilight* system. The possibility to control other types of media and integrate sound and images is also interesting since it could potentially expand the current horizons of tabletop role playing considerably. As it stands, tabletop role playing is a rather isolated art form and would gain immensely by allowing it to connect with more established forms such as music, video and photography.

Document management, which was the first requirement from the users, raises issues of digital rights management. However, providing support for accessing PDF documents from within the *Undercurrents* system is technically not difficult and would be the most direct way of adding this functionality, and would provide a venue for distributing digital props as well. Bookkeeping support would require domain specific data and code but could be added to *Undercurrents* without losing its generality if a meta system to load and unload rule sets was developed. The rolling of dice, could easily be added but an interesting alternative would be to incorporate the shaking functionality from e.g. the *MachDice* application to preserve the physical aspects of die rolling.

Undercurrents is developed to be usable independent of any specific tabletop roleplaying system. This flexibility means that it can potentially be used with computer-supported tabletop role playing systems such as *Stars* [36] or *TViews* [38]. An interesting idea would be if system independent versions of these were to develop since this would allow GMs and players to create mash-ups of various computer-based gameplay tools to suit their specific preferences. Combining *Undercurrents* with the planned *Together Anywhere, Together Anytime* system [54] would allow testing the difference of mediated and non-mediated tabletop role playing. This could potentially allow players to engage in traditional role playing even when separated spatially. The ideas of *Undercurrents* can of course be integrated into computer RPGs to support GMing, possibly creating a closer relationship between computer- and tabletop role playing, but this solution would abandon the idea of being a computer-based gameplay tool and would require the functionality to be implemented in each game.

When it comes to the research of tabletop role playing, *Undercurrents* could potentially be a very useful tool for the researcher. With recording enabled from the computer's camera and microphone, a trove of data on a game session could be gathered, complete with unique focus on each participant. It would allow him or her insight into the workings of the game session without the necessity of being physically present or use a single camera that would miss much of the interaction.

CONCLUSIONS

Undercurrents shows how tabletop role playing can be enhanced with computer functionality without directing the activity. By helping facilitating an activity without actually actively controlling any part it allows GMs and players to decide how the activity should unfold. As such, the system is an example of a *computer-based gameplay tool*, a design solution which can be seen as an alternative to directing and mediated game activities through a computer system.

Even though only a few of the potential features in the system have been implemented and tested, these have been met with approval from players. Further, through the collaboration with presumptive users the design of *Undercurrents* has been ensured to not negatively affect the social aspects connected to tabletop role playing. The additional features can without significant technical problems be added to explore their feasibility in future version of the system. *Undercurrents* may also serve as a bridge to explore how to minimize differences between mediated and non-mediated social interactions since it can be used for both.

REFERENCES
All web references were visited 2009-06-26.

[1] Ackley, J. & Ahern, L. (1997). *The Curse of Monkey Island*. Lucasarts.

[2] Ballagas, R.A., Kratz, S.G., Borchers, J., Yu, E., Walz, S.P., Fuhr, C.O., Hovestadt, L. & Tann, M. (2007). *REXplorer: a mobile, pervasive spell-casting game for tourists*. CHI '07 extended abstracts, San Jose, CA, USA. ACM Press.

[3] Barton, M. (2008). Dungeons & Desktops - The history of computer role-playing games. A K Peters, Ltd.

[4] Benford, S., Magerkurth, C., & Ljungstrand, P. (2005). Bridging the physical and digital in pervasive gaming. *Communications of the ACM*, Vol. 48, No. 3.

[5] Bitcodex. DiceDaemon. http://bitcodex.com/DiceDaemon.html (visited 2009-06-26).

[6] Björk, S., Falk, J., Hansson, R. & Ljungstrand, P. (2000). *Pirates! Using the Physical World as a Game Board*. Interact 2000.

[7] Björk, S. & Holopainen, J. (2004) *Patterns in Game Design*. Charles River Media. ISBN1-58450-354-8.

[8] Bordia, P. (1997). Face-to-face versus computer-mediated communication: A synthesis of the experimental literature. *Journal of Business Communication*, 34, 99-120. Online: entrepreneur.com/tradejournals/article/19218842_1.html

[9] Cage, D. (2005). *Fahrenheit*. Developer Quantic Dream, publisher Atari.

[10] *Campaign Cartographer 3*. ProFantasy Software Ltd.

[11] Cheok, A.D., Goh, K.H., Liu, W., Farbiz, F., Fong, SW., Teo, S.L, Li, Y., & Yang, X. (2004). Human Pacman: a mobile, wide-area entertainment system based on physical, social, and

ubiquitous computing. *Personal and Ubiquitous Computing*, 2004, Vol. 8, pp. 71–81.

[12] Douglas, A.S. (1952). *OXO*. Part of EdsacPC distribution available from http://www.dcs.warwick.ac.uk/~edsac/

[13] Dungeons & Dragons Insider. dndinsider.com

[14] Entertainment Software Association. *Industry Facts*. http://www.theesa.com/facts/

[15] Elder Scrolls series. Latest release: *The Elder Scrolls IV: Shivering Isles* (2007). Developers Bethesda Softworks, publisher Bethesda Softworks.

[16] Eriksson, D., Peitz, J. & Björk, S. (2005). *Socially Adaptable Games*. Proceedings of Digra 05, Vancouver, Canada.

[17] Fallout series. Latest release: Pagliarulo, E. (2008). *Fallout 3* (2008). Bethesda Softworks | Bethesda Game Studios.

[18] Fine, G. *Shared Fantasy: Role-Playing Games as Social Worlds*. The University of Chicago Press, Chicago, (1983)

[19] F ullerton, T., Swain, C., & Hoffman, S. Game Design Workshop: Designing, Prototyping, and Playtesting Games. CMP Books, 2004.

[20] Ultima Collection (1998). Electronic Arts.

[21] Gustafsson, A. Bichard, J., Brunnberg, L., Juhlin, O. & Combetto, M. (2006) Believable environments: generating interactive storytelling in vast location-based pervasive games. ACE '06, Hollywood, CA, USA.

[22] Donner, R. & Johnson, C. (1990). *Minesweeper*. First included in Microsoft Entertainment Pack for Windows 1990

[23] Heinsoo, R., Collins, A. & Wyatt, J. (2008) Dungeons & Dragons: Player's Handbook – Arcane, Divine, and Martial Heroes. Wizards of the Coast, Inc.

[24] Ishii, H., Wisneski, C., Orbanes, J., Chun, B. & Paradiso, J. (1999). PingPongPlus: Design of an Athletic-Tangible Interface for Computer-Supported Cooperative Play. CHI '99, Pittsburgh, PA, USA.

[25] Jackson, S., Punch, S. & Pulver, D. (2004). *GURPS Basic Set: Characters, Fourth Edition*. Steve Jackson Games.

[26] Jonsson, S. et al. (2006). Prosopopeia: Experiences from a Pervasive Larp. ACE '06.

[27] Jonsson, S., Montola, M., Waern, A. & Ericsson, M. (2007): *Game Mastering a Pervasive Larp. Experiences from Momentum*. In Proceedings of Pervasive Games 2007.

[28] Johnson, S. (2005). *Sid Meier's Civilization IV*. Developer Firaxis Games, publisher 2K Games Aspyr.

[29] Kobayashi, M. Mach Dice. Information available from http://www.machwerx.com/apps/MachDice/

[30] Konzack, L. (2008). *Larp Experience Design*. In Donnis, J., Gade, M. & Thorup, L. (2007). Lifelike, proceedings of Knudepunkt 2007.

[31] Klopfer, E., Perry, J., Squire, K. & Jan, M-F. (2005). Collaborative learning through augmented reality role playing. In proceedings of CSCL 2005, Taipei, Taiwan.

[32] Lankoski, P. et al (2004). *A Case Study in Pervasive Game Design: The Songs of North*. NordiCHI '04, October 23-27, 2004 Tampere, Finland.

[33] Le, M. & Cliffe, J. (1999) *Counterstrike*. First developed as a mod for Half-Life (1998). Developer Valve Software, publisher Sierra Studios/Electronic arts.

[34] Lee, W, Woo, W. & Lee, J. TARBoard: Tangible Augmented Reality System for Table-top Game Environment. PerGames '05.

[35] Lindley, C.A. & Eladhari, M. (2005). Narrative Structure in Trans-Reality Role-Playing Games: Integrating Story Construction from Live Action, Table Top and Computer-Based Role-Playing Games. DiGRA '05.

[36] Magerkurth, C., Memisoglu, M., Engelke, T. & Streitz, N. (2003). Towards the Next Generation of Tabletop Gaming Experiences. Graphics Interface 2004.

[37] Mandryk, R.L., Maranan, D.S, Inkpen, K.M. (2002). *False Prophets: Exploring Hybrid Board/Video Games*. In extended abstract of CHI '02, Minneapolis, Minnesota, USA.

[38] Mazalek, A., Mironer, B., O'Rear, E., & Van Devender, D. (2007). *The TViews Table Role-Playing Game*. Proceedings of Pervasive Games 2007.

[39] Metzen, C. & Phinney, J. *Starcraft* (1998). Blizzard Entertainment.

[40] MooTools. http://mootools.net/ (last visited 2009-06-23)

[41] Mueller, F., Agamanolis, S. & Picard, R. (2003). *Exertion Interfaces: Sports over a Distance for Social Bonding and Fun*. CHI '03, Ft. Lauderdale, FL, USA.

[42] MySQL. http://www.mysql.com/

[43] Ohta, K., Shimamura, T. & Yamashita, Y. (2006). *Wii sports*. Nintendo.

[44] Pajitnov, A. (1984). *Tetris*.

[45] Petersen, S. & Wills, L. (2006). *Call of Cthulhu 25th Anniversary edition*. Chaosium.

[46] Peitz, J, Björk, S. & Jäppinen, A. (2006). Wizard's Apprentice: gameplay-oriented design of a computer-augmented board game. ACE '06, Hollywood, CA, USA.

[47] Preece, J., Sharp, H. & Rogers, Y. (2002) Interaction Design: Beyond Human-Computer Interaction, John Wiley and Sons Ltd.

[48] *RedCloth*. http://redcloth.org/

[49] *Ruby on Rails*. http://rubyonrails.org/

[50] Salen, K. & Zimmerman, E. *Rules of Play: Game Design Fundamentals*, The MIT Press, 2004.

[51] *Spider Solitaire* (1998). First included in Microsoft Plus!

[52] Starner, T., Leibe, B., Singletary, B. & Pair, J. (2000). MIND-WARPING: Towards Creating a Compelling Collaborative Augmented Reality Game. IUI 2000.

[53] Sykes, A. *GURPS Character Assistant*. Information available at: http://www.sjgames.com/gurps/characterassistant/.

[54] Together Anywhere, Together Anytime. http://www.ta2-project.eu/

[55] Tychsen, A., Hitchens, M., Brolund, T., Kavakli, M. (2005). *The Game Master*. Proceedings of the Second Australasian Conference on Interactive Entertainment, Australia

[56] Tychsen, A., Newman, K., Brolund, T., Hitchens, M. (2007). Cross-format analysis of the gaming experience in multi-player role-playing games. Proceedings of DiGRA 2007.

[57] Ultima Online: Kingdom Reborn (2007). Electronic Arts.

[58] *Zork I-III*. Included in: Classic Text Adventure Masterpieces of Infocom (1996). Activision.

[59] Warcraft series. Latest release: Pardo, R. (2002) *Warcraft III: Reign of Chaos*. Blizzard Entertainment.

[60] Weiser, M. & Brown, J. S. (1996) *The Coming Age of Calm Technology*. http://www.ubiq.com/hypertext/weiser/ acmfuture2endnote.htm

[61] *World of Darkness Rulebook* (2004). White Wolf Game Studio.

[62] *World of Warcraft: Wrath of the Lich King* (2009). Developer Blizzard Entertainment, publisher Activision.