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**Geocaching: Interactive Communication Channels Around the Game**
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# Geocaching: Interactive Communication Channels Around the Game

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This article presents a study of geocaching, a mobile outdoor game, and explores the interactive communication channels players use. In this case study, 'interaction communication channels' refers to all the means by which players communicate with each other, including devices and services related to the game. This case study was carried out as an Internet survey with twenty-one geocachers. The study also discusses articles, which offer an informative picture of the global game of geocaching, several related applications, communication channels used by players, and new services surrounding the game.

Digital communication channels bring about new varieties of communities, which connect desktop computers to pervasive global networks. Some of these are extensions of non-digital forms of play, while others offer entirely new experiences and playscapes. There are approximately five million people worldwide participating in the game world. Geocaching is a game made by the players, who use GPS technology in a new way, develop it continuously, and create more interactive communication channels and services; it can thus be seen as a pilot test area for game designers and developers. This present study provided a platform for investigating the deeper question of how players use and interpret different interactive channels in the geocaching game while collaborating in locating and finding geocache places, and how players use channels to interact with others. In the Discussion section, conclusions are given in relation to different geocaching approaches and suggestions for future work are outlined.

## Introduction

Collaborative virtual environments provide a computer-generated, mixed reality space in which multiple users can move and interact. As digital games, the Internet, television, and other forms of entertainment capture more and more leisure time, today's active people are becoming increasingly associated with the pervasive games with the most well-established and well-known variants (Montola, Stenros and Waern 2009, p.32). This study explores interactive communication channels around the geocaching game, offering several examples of how communication channels influence the game itself and are developed directly for entertainment for player's. In game design, the driving force is an enjoyable experience for the user. Geocaching is a high-tech treasure hunting game in which adventurous souls equipped with GPS devices track down a stash hidden in a weatherproof, camouflaged box at a location described by latitude and longitude (Ihamäki and Tuomi 2009). The game is already enjoyed by millions of people around the world and is proving to be very popular among families. There are now 1,767,832 active geocaches in 220 different countries (Geocaching.com). The main intention of this article is to describe the instruments,

devices and services of interactive communication used to communicate with other players.

Users present in the virtual geocaching environment can communicate with each other in chat rooms and in a large geocaching forum called *Groundspeak*. Different countries have designated local forums. For example, there are forums for teachers, who use geocaching in education; journalists have a forum in which they share ideas for geocaching articles; in the Game Content and Roles forum, players share ideas and develop the game together. In the game, the virtual environment includes the Internet-based network of discussion forums and chat rooms, as well as applications for cell phones. Examples of the latter are *Trible*, a geocaching navigator and map application, and, an application that supports social networks. GeoBuddy displays all of the geocaches in your area—as well as your own personal GPS data—on USGS topographic maps and your own scanned paper copies of trail and road maps.

There is not a large body of academic research on the application of these systems to other contexts worldwide. The main research question in this study is: what kind of interactive communication channels do geocachers use to communicate with other players? A secondary question is: what kind of tools does geocaching offer to mixed reality game design?

This study provides a way to investigate the profound question of how players use and interpret different interactive communication channels in the game while collaborating to locate and find geocache places. Geocaching is the only multiplayer mixed reality game in which players themselves create and extend the game within different social media and other contexts (such as education and tourism services). This makes it a fascinating game that is, at the same time, much more than just a game.

## Geocaching Approach

According to Geocaching.com, since the 1980s, a group of Finns in Helsinki has played a variation of orienteering in which they hunt locations with a compass and a map. The members introduced professional GPS systems in the 1990s to their game in order to check the accuracy of location information within one hundred meters, and can thus be considered the original geocachers (Ihamäki and Tuomi 2009). Geocaching, which began after the Clinton administration removed selective availability from the GPS system in May 2000, is the twenty-first-century equivalent of the scavenger hunt, using GPS units to find hidden treasure (Sherman 2004). Essentially, it is a sport in which you become a search engine, and can also share your experiences online. The game and its players have invested in the development of communication channels from the beginning: David Ulmer tested his idea by hiding a navigational target in the woods in 2000, calling his idea the "Great American GPS Stash Hunt" and posting it on an Internet GPS user group. Mike Teague was the first to find Ulmer's stash, and began gathering and documenting online posts of coordinates around the world. He created "The GPS Stash Hunt" mailing list to discuss this emerging activity, which he announced to the stash-hunting community on September 2, 2000. At the time of the site's launch, there were seventy-five

caches in the world (Editors and Staff of Geocaching.com and Jack, W. Peters 2004, pp.10-11).

The concept of geocaching is simple: one person puts together a collection of things like toys and trinkets, places them in a plastic box called the cache, measures its position with a GPS device, and posts the location numbers to the website www.geocaching.com. Then another interested player looks up the location coordinates at the same address, finds the cache, takes an item from the collection, and replaces it with another. Caches are hidden in the wilderness, parks or even urban locations accessible to the public (Editors and Staff of Geocaching.com and Jack, W. Peters 2004; Ihamäki 2007).

Geocachers have a strong sense of community and support environmental education: According to Geocaching.com, "Cache Trash Out" is an ongoing environmental initiative supported by the worldwide geocaching community. Since 2002, players have been dedicated to cleaning up parks and other cache-friendly places around the world. Geocaching has become part of many school programs, as it is easy to teach children to use GPS technology and give them skills they will need in the future. For instance, fourth-grade pupils at the Conover Road Elementary School in Colts Neck vicariously travel the world through four travelbugs released into the wild. Travelbugs are actually tags, similar to dog tags, with identification codes on them. A coloured keychain is attached to each bug. A note on the keychain asks the person who finds it to move it one cache closer to the west coast. After the bugs were deposited, geocachers in the area found the tags and moved them to other caches as requested. Geocaching.com tracks the progress of the bugs as geocachers log their identification numbers with the tag's current coordinates. The goal of the project was to enhance the pupils' geography and math lessons through GPS technology; the children have been plotting the distance on a map every time a bug arrives at a new location (Morton 2009). Geocaching was also adopted at Sterling and Francine Clark Art Institute, where Earth Day (April 22) was celebrated with the launch of a new GPS program ('Clark Celebrates Earth Day by Kinking off GPS Program').

Geocaching has spread to other areas, such as education and tourism, more than other mixed reality games, mainly because of its use of interaction instruments and its active user community. For example, in North Vancouver, newcomers can use a network of geocache locations to find out about the large and unique collection of public art on display in the community (Skelton 2009).

The game has various benefits for tourism as well, since geocaching can be seen as an adventure tourism activity. The Minnesota State Park Safari offers a Geocaching Wild Safari: each of Minnesota's seventy-two state parks and recreation areas has its own Critter Cache, and some 20,000 geocache finds have been recorded. This adventure, which will offer three more years of treasure hunts throughout the state, is aimed at motivating people to get out and have fun; there will also be park-specific quizzes and puzzles to solve en route to the cache. In the future, the Safari will offer Geocaching 101 programs in the metro area (Minnesota State Park Safari 2009).

These examples describe the way geocaching players understand potential areas of support for the game itself. Players want to extend their own experiences as players,

and use interpretative media tools to extend the game across social media platforms. Players are starting to bring geocaching to everyday life and the impact of setting up, crossing and breaking the boundaries between game and non-game. Taylor (2006) notes that 'virtual' spaces leak into 'real' world and that the practices of play are integrated with those of everyday life.

## Mixed-reality Social Gaming

New technologies are making substantial progress in seamlessly merging the virtual and the real worlds in mixed reality (MR) games. There are many differences between traditional and computer games. Most traditional games still provide much easier interaction with the environment or with other players (Braun, McCall, Broll 2008). Today's mainstream entertainment revolves around interactivity. In particular, players want full immersion entertainment experiences in intelligent environments. Games are often played in groups, because players want to enjoy rich social interaction with friends, family and work teams (Cheok, Sreekumar, Lei, Thang 2006).

People often like games that are played in groups so that they can put their abilities of social interaction into use. A good example of this phenomenon is that geocachers have geocaching events. In these kinds of group games we apply our skills of physical and social interaction in a special manner according to the game's rules (Cheok, Yang, Ying, Billinghurst and Kato 2002). While participating in the geocaching game, we can have the full level of physical and social interaction within the game context. The extent of interaction is only limited by the geocaching game rules. The game and entertainment industry develop and extend the usage of new technology: They are the major drivers of technology as regards the development of innovative interaction devices and efficient game engines (Matysczok, Radkowski, Berssenbruegge 2004). The subsequent consequential step is to play games everywhere, even on holidays, to include the game player completely in the game and to integrate the game into real life as in the geocaching game.

The research in this article provided a way in which to investigate the deeper question of how players use and interpret different interactive channels in the geocaching game while collaborating in locating and finding geocache places. More specifically, the project explored:

- the impact of GPS inaccuracy on the use of location as key component of content and context information for caches.

- the use strategies of interactive channels that geocachers apply to achieve successful collaboration.

In this paper, the background theory, implementation and demonstration results are presented in detail. A research area related to this study is Mixed Reality Game studies. The content of this paper is structured as follows. Section 2 clarifies the article's methodology. Section 3 presents the definitions of Mixed Reality and interaction in MR games. Section 4 clarifies results in geocaching games' use of empirical dimensions of interactive communication channels. Section 5 discusses

fieldwork findings. Finally, Section 6 draws the main conclusions and outlines possibilities for future work.

## Study Methodology

Geocaching connects new technology, outdoor life, and people in many ways. All geocachers who participated in this study are interested in new technology and use the Internet and other digital devices and services on a daily basis. Geocaching has been so appealing that the activity has grown from a few dozen enthusiasts to hundreds of thousands in only nine years. Passion for the game has quickly spread as players combine their love for outdoor life with their interest in modern technology. This case study focuses on the global interactivity made possible by the invention and application of GPS technology; its purpose is to find out how a group of new users uses global interaction communication instruments, services and personal devices.

## Case Study

A case study is defined by Yin as "an empirical inquiry that investigates a contemporary phenomenon within its real-life context, especially when the boundaries between phenomenon and context are not clearly evident". It can be conducted as a single-case or a multiple-case design. A single case can be used when the case is extreme or unique (Jääskeläinen 2001, p.106). Rich description (see Geertz, 1973; Shank 2002) or a good story (Dyeer and Wilkins, 1991) have often been considered the goal of the classic case study: the former presents cultural meanings related to the case, while a good story in itself is thought to create theory, based on the concept that a major quality of human activity is to look for relations, bring pieces together to construct wholes, and to gain a greater understanding of the world (Bruner 1991). An understanding of the world is furthered by stories; thus a plot can be considered a theory (Charniawska, 1998). Therefore, the classic descriptive case study is not merely narration or general descriptive writing without connections to theoretical reasoning. The goal of description can also be to depict observed or innovative uses in everyday situations; this kind of case study is known as illustrative, and can be useful in yielding information on the shape and nature of existing uses (Ryan et al., 1992, p.114).

The case study methodology allows an integrated and interpretive analysis. This article uses a method called interaction analysis to inform ethnographic exploration: this is an interdisciplinary method used to investigate interactions of human beings among themselves and with objects in their environment. Even though this technique was originally used for video analysis, it provides a number of useful foci for understanding the social awareness phenomenon in an academic environment. This article focuses on the following categories: forms of awareness, activities of awareness, agents of awareness, places of awareness and contents of awareness (Vyas, van de Watering, Eliens and van der Veer 2007).

'Forms of awareness' describes different methods of communication used for mediating awareness information. These can either be synchronous (e.g. face-to-

face interaction and phone calls) or asynchronous (e.g. e-mail and instant messaging tools). Methods for communicating awareness information can be explicit, providing direct indications, or implicit, leaving room for multiple interpretations (Vyas, van de Watering, Eliens and van der Veer 2007).

'Activities of awareness' describes the type of activities within the environment that could mediate awareness information. These can be task-oriented (i.e. creating geocaches) or special in nature (i.e. geocaching events); often these activities overlap, so it is important to take into account the possible relationships between them (Vyas, van de Watering, Eliens and van der Veer 2007).

'Agents of awareness' are the people and objects or artefacts in the environment that mediate awareness, directly or indirectly. People can be seen as individuals and also as constituting groups (e.g. the local geocaching community or research groups). In this article it is important to understand the roles that ethical issues such as position hierarchy play in social awareness. It is also important to take into account the role of students in forming social awareness within the educational environment (Vyas, van de Watering, Eliens and van der Veer 2007).

'Places of awareness', in a broad sense, describes the geographical as well as the 'social spaces' in which interactions take place, including the hotspots of interaction. This can be seen as a multi-layered concept: personal vs. private spaces of staff members within a workplace, a building and whole (treasure hunt) environment. Observations call into question categories of awareness: How does, for instance, the spatial layout influence the structure of interaction?' (Vyas, van de Watering, Eliens and van der Veer 2007)

'Contents of awareness' refers to the actual information being mediated through different interactions. These can be staff members' activities, presence, social status, achievements, and so on, and can either be explicit (i.e. a note saying that a person will be back at a certain time) or implicit (i.e. artefacts used as symbols or information 'at a glance'). Each (but particularly the implicit) is open to different interpretations by different people (Vyas, van de Watering, Eliens and van der Veer 2007).

## Participants

Participants filled out a structured enquiry on the Internet. This case study was carried out with twenty-one geocachers, of which nineteen were male and two female. The average age of the participants was forty-two, and ranged from sixteen to sixty-three. Notably, middle-aged people constituted the most interested age group. Geocaching is played all over the world; the participants in this study were from eight different countries (illustrated in Figure 1). Players were chosen randomly; invitations to participate were sent using the snowball sampling method in October 2009.

We gathered information on the players' backgrounds and technological orientations, (illustrated in Table 1). Players chose the options that best described their opinions from the following statements:

| Statement | Average value |
|---|---|
| I think that technology is necessary in my everyday life. | 6,2 |
| I am among the first in my circle of friends to buy new devices. | 4,3 |
| I help my friends and relatives using technical devices. | 5,5 |
| I edit content on Wikipedia etc. | 4,4 |
| I share information about myself on the web, for example on Facebook or MySpace. | 3,5 |
| It would be great to know where my friends are and what they are doing. | 3,0 |
| It would be great if my friends knew where I am and what I am doing. | 3,7 |
| Spreading and abuse of my personal data on the web worries me. | 5,5 |

*Table 1. Geocachers technological orientation (1 = Completely disagree; 4 = Neither agree nor disagree; 7 = Completely agree)*

In this study, the players were technologically oriented; we can call them 'lead users', as they are among the first to buy new technological products. Technology is necessary for them in their everyday lives: they hold good technological skills and can easily help others with their own technology. They have solid knowledge of both the benefits and disadvantages of new technology.

## Geocaching Survey

The methodology of a case study allows an integrated analysis (interpretative case study, in Lijphart, 1971 terminology), which is useful in the exploration of many research subjects. The distinguishing characteristics of case study analysis are derived from attempts to examine a contemporary phenomenon in its real-life context (especially when the boundaries between the phenomenon and the context are not clear). This data collected in this article use a research technique called qualitative content analysis, "a research technique for the objective, systematic, qualitative description of the manifest content of communication" (Berelson, 1952, p.519). This qualitative case study was carried out as an Internet survey for geocachers in October 2009, and is based on twenty-one responses. Secondary material is based on geocaching stories in magazines all over the world, linked to Geocaching.com, that are used here to expand the description of interactive communication instruments and of how geocaching is used in tourism or to design new applications around the game.

Internet enquiries were sent to the Groundpeak forum with a request for geocachers to participate in this case study. It was also sent via email to a randomly selected set of players. It is based on a geocaching online survey, "The Implications of Geocaching to social interaction and tourism". With this survey we aim to understand what kind of implications geocaching as a hobby has for, for example, social interaction, travel, and general lifestyle and behaviour. This case study analyses a

part of the six-page survey material and includes a small sample of the eighty total participants.

To develop successful mixed reality interaction communication instruments for games, it is vital to understand potential players' subjective interaction communication tools and how they function in relation to the proposed service, as well as the players' expectations of the user experience.

## Mixed Reality: A Definition

Mixed reality (MR) is a concept that includes the perception of and interaction with reality and virtual reality (Träskbäck 2004, p.13). All mixed realities share a common philosophy: Husserl and Gibson (1931) discussed how the artificial world interacts with the physical world of everyday human activities in order to enrich the experiences of perception, affordance and engagement. MRs are often used in a highly specific context; the differences between their concepts of reality are not clearly identified and their attributes are vaguely defined. MR merges both real and virtual realms. According to Milgram and Colquhoun (1999), MR distinguishes between the realms of Augmented Reality (AR) and Augmented Virtuality (AV), two major subsets lying within MR range of the Reality-Virtuality (RV) Continuum. MR is thus related to AR, a term that has begun to appear in the literature with increasing regularity. AR is an environment in which the additional information generated by a computer is inserted into the user's view of a real-world scene. A Mixed Environment (ME) has physical and digital elements that interact and intermingle in a more expansive form (Schnabel 2009, pp.4-6). By merging a range of digital and physical media, the design can be enriched by different perceptions, comprehensions and conceptions of spatial volumes within both physical and virtual environments (Wang et al. 2003). The variety of different media transforms the design process from a tangible to a virtual portrayal of design, and vice versa (Schnabel 2009, p.6). The power of MR is its ability to seamlessly combine, via virtual reality, the fantastical worlds of the imagination and the compelling aspects of reality, bringing players into physical proximity and helping them regain natural interactions (Bowlby 1983).

Falk et al. (1999) introduced the concept of Amplified Reality to complement Augmented Reality. Amplified Reality increases the natural properties of real elements and accentuates the experiences they create within reality. AR is about how the user perceives reality, while Amplified Reality influences how the perceived reality is made available to him or her. An amplified object controls the flow of information; in an AR system the user is in control of that information (Falk et al., 1999). Geocaching has amplified reality content within virtual cache places in the real world. For instance, Geocaching.com shares virtual cache locations on the Internet, meaning that the cache is in the real world, but there is no plastic box, the usual treasure found in cache places. Players have typically made virtual caches in places where boxes cannot be hidden.

MR techniques have proven valuable in single-user applications, but there has been less research conducted on collaborative uses. MR techniques can be used to enhance communication regardless of proximity; hence, it facilitates the development of collaborative interfaces that go 'beyond being there'. MR also supports seamless

collaboration with the real world, reducing the functional and cognitive seams between participants. MR interfaces can enable co-located users to view and interact with shared virtual information spaces while simultaneously viewing the real world; this preserves the rich communication bandwidth that people enjoy in face-to-face meetings, while adding normally invisible virtual images. The key characteristic of this interface is the ability to see the real world and collaborators at the same time as the virtual web pages floating in space. In Billinghurst and Katos study, users/players are able to easily spatially organise web pages in a manner that facilitated rapid recall; the distinction between public and private information was found to be useful for collaborative information presentation (Billinghurst and Kato 1999).

## Interaction in MR Games

MR games, AR games and mobile edutainment applications represent a major advancement for game players and developers. Such games use information and communication technology (ICT) to overcome the boundaries of traditional gaming environments by creating new, extended ones in which the real environment of the user becomes an intrinsic component of the overall game. By joining both worlds— the real and the virtual—they integrate the social quality of traditional games into computer games. Therefore a key aspect is the seamless integration of geocaching games into our everyday situations and public environments (Herbst, Braun, McCall and Broll 2008). In academic research, an emerging field involving so-called pervasive games, mobile MR games and location-based games explores gaming taking place in the physical world. Geocaching is essentially a game of catch involving online and real-world players, in which the real-world players move through a real environment to find caches and online players can search for the nearest and newest cache places or keep in touch with each other. The particular focus in this study is on geocaching as a mobile MR game; the game exists in a boundary zone among MR games because its play fields exist in both real and Internet environments, serving different game functions. Geocaching has multi-player online game elements, such as global competition among players for points, number of caches found, or the First-To-Find (FTF) award, a highly coveted merit (Horsman 2005).

The main classification proposed for the MR geocaching game in this work is based on the physical world requirements demanded by the game, with which the virtual world can be involved at the same time. Geocaching takes advantage of the natural mobility of devices such as mobile phones and PDAs, which are independent of the area of play. Players can contact each other through discussion forums or chat rooms, or find hints on the geocache.webpage interface at Geocaching.com. New technologies are making substantial progress in seamlessly merging the virtual and real worlds in MR games. There are many differences between traditional and computer games; most traditional games still provide much easier interaction with the environment or with other players (Braun, McCall and Broll 2008). Of the myriad communication platforms available today, none demonstrates the complexity of twenty-first-century social interaction strategies in quite the same way as massively multiplayer online games. As the first interactive mass medium to unite entertainment and communication in one phenomenon (Filiciak 2003), these games present a tremendous opportunity to explore a nascent area of media convergence, and to

understand how the naturally occurring phenomenon of self-motivated social learning and collaborative problem-solving reflects the growth of twenty-first-century skills (Galarneau and Zibit 2006).

Jegers (2008) defines pervasive games and their difference from traditional computer games using three specific characteristics: 1) mobility and place/time choice, 2) social interaction as a driving force in game play, and 3) integration of physical and virtual worlds. Today's mainstream entertainment revolves around interactivity; players want fully immersive entertainment experiences in intelligent environments. Games are often played in groups, because players want to enjoy rich social interaction with friends, family and work teams. One of the main reasons players enjoy certain games is that they are social activities; social gaming has gained in popularity (Cheok, Sreekumar, Lei and Thang 2006). Csikszentmihalyi introduced the original concept of flow, defining it as "the holistic experience that people feel when they act with total involvement". This definition suggests that flow consists of four components: control, attention, curiosity and intrinsic interest. When in the flow state, players become absorbed in their activity: their awareness is narrowed to the activity itself, they lose self-consciousness, and they feel in control of their environment. Such a concept has been extensively applied to a broad range of contexts such as sports, rock climbing, gaming and geocaching (Csikszentmihalay and LeFevre, 1989). Flow is treated as a multi-dimensional construct with characteristics including control, concentration, enjoyment, curiosity, intrinsic interest, and so on; in this present article it is defined as an extremely enjoyable experience in which an individual engages in a geocaching activity with total involvement, enjoyment, control, concentration and intrinsic interest. Nevertheless, we considered geocaching an entertainment-oriented technology. Nezlek and Leary (2002) showed that enjoyable and responsive interaction increases people's life satisfaction scores. However, players enjoy physical and social interactions with each other, and this largely disadvantages network games, since they do not give people the opportunity to interact physically. The limitation of technology is that it has segregated different levels of interactivity within different media forms. Stapleton, Hughes and Moshell (2002) argue that, as science and technology advance, there will be a convergence of levels of interactivity within each game controlled by artistic convention, by storytellers, or by audience members. We will, they suggest, be able to transition easily between these levels. The ultimate challenge, therefore, is to create media in which author and audience can choose the level of their interactivity at any point within the game. This would be dependent upon the convergence of artistic convention with all the interactive modalities of MR. In mobile MR games using mobile devices, the organisation of the game field has been given new forms; the physical distances between players also influences its structure and proportions. Players' networked and interchanging game fields—close to, overlapping with, and within each other—are novelties in games' use of space; taking advantage of these novelties has only just begun. As geocaching illustrates, it is possible to hide information in our physical environment that can be perceived only by certain games, a fact that should also interest designers of advertisement games. Thus, the virtual and physical game fields have an increasing influence on, and can be included in, one another (Eskelinen 2005). Combining the virtual and real domains leads to new interaction paradigms such as tangible interfaces, which are considerably more attractive and intuitive than traditional ones. For electronic games, this technology offers even more advantages.

## Results

## In geocaching game empirical dimensions of interactive communication channels

In general, participants were technically oriented, which is why the equipment they use for geocaching is important. Geocachers' equipment describes their interaction with devices and with other players. Geocaching as a hobby has motivated the participants to use technology, and in some cases even to create websites and map services for the game. Table 2 describes the equipment the participants use for geocaching.

| Technology and devices players used in the geocaching game |
| --- |
| "Just a handheld GPSr". (JBT 2009). |
| "I used to use a Garmin Nuvi 350 for geocaching but it ended up breaking, so I recently purchased a Garmin Oregon. I use that along with my camera (a geocaching must-have) to geocache". (ky.m.guy 2009). |
| "PDA and GPS plus TomTom if driving". (Male58 2009). |
| "We have of course our GPSr. We started out using a Garmin 12, but have since upgraded to a Garmin 60CSx. We still carry the 12 as a backup.  We also have a palm pilot which we store the cache info. And then we have our cell phones, which have internet access" (mlscls 2009). |
| "Simple GPS - no maps" (tomtwogates 2009). |
| "Only my GPSr - occasionally I use a cellphone to phone other cachers if I have a problem with a cache I am doing, but that is rare" (besem 2009). |
| "I use a Palm Treo cell phone and external Bluetooth GPS receiver" (grenoble 2009). |
| "Mobile with Gps Pda with Gps" (mickyz 2009). |
| "iPhone and GPS receiver" (Richard701 2009). |
| "The usual: GPS, compass, phone, minilaptop with GSM" (Male55 2009). |
| "Pda (HP Ipaq) Bluetooth gps" (keehotee 2009). |
| "A GPS, a pen, and usually a bicycle" (hguijt 2009). |
| "Wireless communication on the phone. Two GPS devices. Digital Camera" (GEO BEAR 2009). |
| "Vehicle, GPS, cooler box, first aid kit. mobile phone, camera, video camera, laptop" (DamhuisClan 2009). |
| "PC, Garmin Oregon and/or Garmin e-Trex Legend, Garmin Street Pilot 320, iPhone" (Cowboneneck 2009). |
| "GPS receiver, PDA, digital camera" (Blue Man 2009). |
| "Garmin oregon" (AstronomerDave 2009). |
| "iphone, car" (ashallond 2009). |

| "Hacked Mio GPS with Windows CE platform for paperless caching" (Female34 2009). |
| --- |
| "Gps, itouch and PC" (Figufer 2009). |
| "I use my satmap Active 10 to find the caches, and my Blackberry storm to receive updates about new caches and to view the Geocaching.com website" (Gooner 2009). |

*Table 2. Participants' equipment.*

Participants are technologically mediated by their social experiences, both on the Internet and in physical environments. Geocaching is potentially subversive in that it makes individuals more aware of omnipresent surveillance technology, while providing ways to use it in playful, unanticipated ways.

In this article we explore the various aspects of human interactivity in geocaching with regard to its interactive communication tools. When players act together, they usually have a shared understanding of what is going on, the awareness of which directs their action. Interaction with information technologies is largely different from social interaction: the player and the device do not necessarily share an understanding of 'what is going on', but information from the device directs the action, just as other participants' actions do in human-human interaction (Raudaskoski 2009, pp.141-142).

## Fieldwork Findings

**'Forms of awareness' describes different methods of communication used for mediating awareness information** (Vyas, van de Watering, Eliens and van der Veer 2007). Gram-Hansen (2009) describes in his study how it is fascinating that geocachers spend time and money on a game in which players have to negotiate the rules and provide the content for each other. The official website for the game provides a framework for the hobby, but all content shared is user-generated. This reflects geocachers' motivation for the game. The game also opens possibilities for experimental technical applications: for example, Trimble (Nasdaq: TRMB) announced the availability of a free, ad-supported version of its Geocache Navigator™ application for selected series of 60 Nokia devices with integrated GPS capabilities. Geocache Navigator is the only application that brings geocaching capabilities to the mobile phone and provides real-time access to Groundspeak's Geocaching.com, the largest geocache database in the world (Ernst, Maggs and McNabb 2008). Players can also use Apple's iPhone™ to access the Groundspeak forum with a geocaching application. The iPhone 3G/3GS uses a combination of GPS, -positioning, and cell towers to determine approximate location. iPhone application queries the Geocaching.com database in real time and provides a list of nearby geocache (Geocaching.com). Users also share their own software in the Groundspeak forum.

Geocachers use technology for their hobby; what makes this interesting is that their equipment has a special meaning here. Geocaching involves individuals mediating between the Web and the world, using technologies developed for the military in a

distinctly non-militaristic way. They are interested in technology development and find other services that are beneficial for the game.

However, in this case study, five players used no services at all. Technical skills play an important role, because some of the players use their own software to play: *Statistical* software to run off my stats and plan my routes" (Richard701 2009). Geocachers use map sources and other services, for example 'GSAK, Geosetter, Mapsource, Google Maps, Google Earth, POI Loader, GSAK Forums, Groundspeak Forums, etc.' (ky.m.guy 2009).

A major technology trend in the past 50 years has been the 'digital revolution'. Geocaching integrates mobile phones, GPS technology and electronic services. The geocaching community has a great deal of knowledge of new technological aspects; members want to share their innovations, work and skills globally. Caches are even being set up as company team-building exercises, just as ropes courses and climbing events have similarly become popular. The sport has grown from its quasi-'cult–like' roots to being a marketed, accepted outdoor activity complete with retailers that stock 'geocache-ready' equipment manufactured by a new segment of outdoor vendors. Geocaching is envisioned as a growth segment of their business, and retailers are beginning to cater to the unique needs of geocachers as a distinct market. The technological know-how for the game came from the GPS device, which amateurs began to use in their own ways; the small group of enthusiasts who want a GPS receiver just to participate in geocaching is actually a very diverse group, ranging from twenty-somethings eager to be on the cutting edge of a new trend to a large population of retirees seeking to maintain a healthy, active lifestyle while participating in a sport that can be enjoyed at a leisurely pace. Getting involved in the sport will not only help you make sense of your GPS receiver, but also help you meet your own personal goals and needs. This small group of enthusiasts has chosen to label themselves 'Generation GPS' (Dyer 2004, pp.9-10; Ihamäki 2006).

As a result, geocachers have many interactive communication instruments: for instance, the geocaching website offers player-created tools and the Groundspeak forum. Geocaching has grown to such a level that some of the products created by players are taken to be manufactured industrially and are sold by retailers specialising in geocaching equipment (Dyer 2004, pp.6).

**'Activities of awareness' describes the type of activities within the environment that could mediate awareness information** (Vyas, van de Watering, Eliens and van der Veer 2007). Local communities are also important communication resources for geocachers. "I use my local (and not-so-local) contacts but not much else besides geocaching.com. I suppose purchasing things from Landsharkz, Cachers Toy Box and the like would count" (Comboneneck 2009). We also found some evidence of preference for new geocaching services, which will be widely available in the future: One geocacher says that he/she "is able to upload photos to Geocaching live beta with Samsung Jet" (mickyz 2009). Others feel that "having web-access in the field would surely be nice, but so far I find I can do without" (hguijt 2009). Geocachers want easier access to faster wireless connections for a better price. The Groundspeak forum has hundreds of groups; Yahoo has groups dedicated to geocachers in California, Florida, Utah, Belgium, the United Kingdom, and many others (Editors and Staff of geocaching.com and Peters 2004, pp.219).

Over time, geocaching could become more popular than treasure hunts. Its rise has been an excellent example of virtual marketing, a modern, Internet version of word-of-mouth. In addition, companies are beginning to notice the geocaching market, and at least one firm is developing corporate team-building events based on it's ideas (Sherman 2004, pp.7).

**'Agents of awareness' are the people and the objects or artefacts within the environment that mediate awareness, directly or indirectly** (Vyas, van de Watering, Eliens and van der Veer 2007). Today computer entertainment games are designed for multiple players. They are attractive because they offer players the opportunity to compete and cooperate. Players can use wearable computers, for instance, and make physical gestures and movements as part of their interactions with each other. The social experience is not just about providing multiplayer experiences in which geocachers can compete and collaborate, but also about promoting strong emotional involvement by introducing direct face-to-face interactions (Cheok et al. 2006).

As a result of the social interaction of geocaching, participants have made numerous friends and enjoyed attending caching events: "I have made many new friends/acquaintances and enjoyed a few events with local and not-so-local cachers. Caching in Mexico was fun and we met lots of nice people" (Cowboneneck 2009). When geocachers meet at events, interaction between players happens face-to-face. We have discussed the technical background of social and physical interactive paradigms and provided examples where users interacted both socially and physically in a physical or virtual environment; nonetheless, thousands and thousands of people continue to geocache each day. In at least this portion of their lives, players are rejecting the discourse of fear and mistrust of others, instead developing new ways to promote trust and extend community. The geocaching version of trust is facilitated by some of the specific regulating mechanisms built into the game. Geocachers are adding to the store of social capital by behaving in ways that increase social cohesiveness, interpersonal trust and community.

"In the Netherlands, the first people I met were geocachers, and we went geocaching as a group on several occasions. Outside of geocaching we haven't had a lot of contact, barring over Christmas and New Year's. In South Africa, I'm still too new on the scene to have made any social contact of note. I have, however, had semi-regular email contact with some of the local cachers" (besem 2009).

Interaction between players is not necessary for the game, but players mention that they became more interested in geocaching after interacting with its different tools. Some participants do not have much interaction with other players: "None at the moment, however I endeavour to meet new people and interact more with the geocaching community in the future" (Gooner 2009). Gram-Hansen (2009) maintains that a geocache creator can use the element of play to get a message across. As mentioned earlier, the nature of this message can extend from geocache to geocache, but it is entirely conceivable that persuasive intentions that would otherwise be realised through conventional technologies can be transferred to this domain as well.

**'Places of awareness', in a broad sense, describes the geographical as well as 'social spaces' where interactions take place, including the hotspots of interaction** (Vyas, van de Watering, Eliens and van der Veer 2007). Geocaching.com keeps a list of geocaching events around the world. Because the game relies on the Internet, most clubs are rather electronic communications-savvy. Another organised form of geocaching involves teams, groups of people who hunt together (McNamara 2004, pp.177-178); they may all live in the same area and hunt together, or simply work as a virtual team to find particularly challenging caches. A classic example is the notorious "Blood & Guts" cache, located somewhere in the Eastern United States; so far only a few people have been able to locate it. To find the cache you must solve a series of puzzles. Virtual teams comprising geocachers from all over the world have formed to try to unravel the clues needed to discover the locations of some of these hard-to-find caches (McNamara 2004, pp.177-178). Geocaching events are always special because they are situated in different places, even different countries, and each event has a new organiser. Geocacher Kuukkelit (2007) gives the example of an event called "Backside of forest": Central Finnish hospitality, enjoyed with a thin pancake. At the event players give hints and seek caches together. The participants share geocaching to have experiences with each other. Present at the event was also geocaching equipment company named "Kivenalla", where players could buy [equipment]. The event also presents a subculture within [the] geocaching game".

**'Contents of awareness' refers to the actual information being mediated through different interactions** (Vyas, van de Watering, Eliens and van der Veer 2007). Geocachers are users of the Internet and of GPS devices, but they are also innovators. They started a technology trend by showing a new direction for the field of gaming through GPS technology. Geocaching.com has a link to a benchmark hunting section, in which you search for survey markers that are physical references to location and height. Benchmarks are reference points left by survey teams: the National Geodetic Survey (NGS), the US Army Corps of Engineers, the Bureau of Land Management, and various other state and local organisations. The NGS keeps a database of these benchmarks, and the Geocaching.com benchmarking feature has a copy of that information (Sherman 2004, pp.165). Geocaching.com also presents a "Pocket Queries" service for premium members, which allows them to receive a listing of caches tailored to their interests and able to be uploaded as an eBook to a PDA (Editors and Staff of Geocaching and Peters 2004, pp.52).

As the popularity of geocaching continues to grow, articles, events, clubs and organisations are springing up all over the world, and the community's technological know-how is increasing with the influx of new players. Geocachers are very media-oriented people; using online journals, users can make their geocaching stories public, private, or viewable to friends only. Livejournal, which allows its members to create communities, has an active geocaching forum where visitors can read and comment on stories from fellow geocachers from all over the world or post their own (Cameron 2004, pp.81). Hollywood did not wait long to jump into geocaching either: 20th Century Fox created "Project APE" (Alternative Private Evolution), a marketing campaign to promote the 2001 remake of *Planet of the Apes*, for which they set up twelve movie-related caches and thus opened a brand new avenue for marketers worldwide (Cameron 2004, pp.62).

## Design Guidelines

In the following section we present our guidelines for designing mixed reality social games, which use geocaching ideology. Overall, many of these guidelines can also be used in designing other kinds of mobile mixed reality services.

1. Support sharing of experiences in communities

Description: The service should support collaboration, combining experiences with other users and managing and viewing them together.

Example: As the popularity of geocaching continues to grow, geocaching articles, events, clubs and organizations are springing up all over the world and the technological know-how of the community increases with the influx of new players. Geocachers are very media-orientated people; for example users can make their geocaching stories public, private or viewable to friends only in You.Tube. Geocaching as a hobby has motivated the participants to use technology, and in some cases even to create websites or blogs around the game and publish their own geocaching video experiences in YouTube. Geocaching video co-experience opens new possibilities in design for user experience by focusing on the role of technology in human action (parallel ideas can be found in the concept of embodied interaction boorish 2001).

2. Provide features for going through the recent events to support event-based sharing

Description: The idea of being able to browse easily through the recent events with several users. The service should provide features for easily sharing of records from the event with people who might be interested.

Example: Geocaching.com keeps list of geocaching events in the world. Because geocaching relies on the internet, most clubs are pretty electronic communications-savvy. Another organized form of geocoding involves teams, which are groups of people who hunt together (McNamara 2004, pp.177-178). The official Blog of Geocaching.com called "Lattitude 47" according to the creators of the World Wide Flash Mob (WWFM) event, Sonny and Sandy of the Podcacher Podcast a WWFM is, "meant to be a fun like opposite of a Mega-Event. It has crammed into 15 minutes of excitement. The letters "WW"- World Wide, represents an added dimension. These events occur across the planet on the same day at the same time. These caching events are intended to bring geocachers together in creative way, as well as introduce others 'newbies' to the hobby. A WWFM event usually involves geocachers quietly gathering. They pretend they don't know each other. When the chosen time arrives, geocachers perform prearranged tasks like pillow fighting, bubble blowing, or flying paper airplanes. All the geocachers sign the logbook, then after 15 minutes, they quickly leave. Many geocachers meet up later to go geocaching together.

3. Provide features for software sharing and management

Description: during the study, I found that users' creation, sharing, organizing and browsing of the geocaching experiences were so predominant that geocaching softwares should be utilized in new services for sharing other game developments.

The service should provide features for the easy sharing of their self-made software with other users who might be interested.

Examples: Geocachers are a group of people who use the internet and GPS devices, but they are also innovators. They started a technology trend by showing a new direction for the game field adding GPS-technology. Geopt "Geocaching Tools" is a set of tools that facilitates the uploading of multiple photos. Geocachers could easily to use Geocaching Tools for example upload of multiple photos, they can manage the logs online by upload photos automatically to logs and manage trackable giving you the option to do discovers and retrieves from the cache, to move for the collection and inventory several trackables at once. (Geocaching Tools, 23.5.2012 http://www.geocachingpt.com/) It is interesting that geocachers are very involved in technological development, and constantly develop all kinds of applications to help both the geocaching game and other users.

## Conclusions and Future Work

This article has presented geocaching, a mixed reality game, and shown how players use interactive instruments in geocaching contexts to achieve successful collaboration. The results described geocachers' interactive communication instruments, such as the Groundspeak discussion board, the Groundspeak iPhone application, the Geocache Navigator™, GPS systems, mobile phones, laptops, GSAK forums, Geosetter, and Geocaching chat, among others. Geocaching illustrates the types and components of the interaction appearing within multiplayer games, the elements of which must be understood and taken into account when designing new multiplayer games. As social media has taken on a more important role in our everyday lives, it has also become an increasingly involved part of geocaching's context, structure and social network. These networked social games are a wholly new form of community, of social interaction, and of social phenomena. Social spaces are being moved online, making it quicker and easier for people to find and communicate with a particular niche of society. This study has investigated the proliferation of interactive instruments used in geocaching. New instruments help further create and develop the geocaching culture. Creative geocachers are also able to develop new instruments for the game. This study has connected geocaching with embodied computing elements, both of which operate on three levels of interaction: human-to-physical-world interaction, human-to-human interaction, and human-to-machine interaction.

So that players can geocache everywhere, even on holidays, and so that they are included completely in the game, which becomes integrated seamlessly into everyday life, new and innovative technologies like augmented reality should lead the way in game design. I suggest that the Internet both contributes to affects social capital and community engagement: it can enhance the lives of communities by creating MR environments in which people with kindred interests, but who do not live near each other, can 'convene'. Geocaching chat groups tend to focus somewhat narrowly on their shared interest, which is both useful in consolidating bonds and troubling in that it does not leave room to extend the parameters of conversation or of contact.

Geocaching illuminates ways in which we are indirectly testing out new forms of community that are made possible by computers. Apparently, it creates more contexts for consolidating existing bonds and creating new interpersonal connections. The interaction devices has integrated through wireless systems into the device network. Geocaching's ability to make environments for a new activity that are personally and socially interesting and also useful in tourism and education fields is precisely the reason it merits attention. It allows us to glimpse new human-machine interfaces, and to understand the ways in which individuals in a privatised, fearful culture are striving to create situations that promote trust and define modes of community that are both forward-thinking and satisfying.

Geocaching offers MR game designers different kinds of services and tools. Players are making new channels to communicate with each other and to involve more players in the game. Implementing the same kind of game play for the mobile phone as for the PC or console does not often make sense for a typical multiplayer online game, but many of the activities that geocachers perform with different equipment do truly require rapid interaction. The study suggested guidelines, which rise up in fieldwork findings. This case are studying geocaching, studying players' experiences, and starting to design new interactive MR applications for users in the future.

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