Engagement, Motivation and Inspiration: The SciMyst Framework in Museums

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Abstract

In this paper we present the concept and technical architecture of the SciMyst pervasive mobile game. Encouraged by the positive experiences of game deployment at the SciFest2007 science festival, in Joensuu, Finland, we discuss means to use SciMyst in the context of museums with an aim to boost visitor engagement and interaction with the surrounding environment. As the result, we propose an array of novel technologies to be used in the SciMyst framework for museums.

Keywords

Pervasive computing, ambient intelligence, museums, sensors, smart environments, interaction.

INTRODUCTION

Museums are places where visitors explore collections for inspiration, learning and enjoyment [11]. Additionally, as Handler [12] puts it, museums are firstly a "social arena, not a repository of objects." The understanding of these definitions invites computer scientists to reflect on how the novel technologies can be used to expand the meaning of museums in relation to their visitors. The problem is, however, that museums in their conventional form do not engage the visitors to explore and learn as much as they could. Furthermore, the informative texts located next to the presented objects are seldom, if ever, adapted to the existing knowledge of the visitors.

Several museums have developed auditory playback systems to compensate the need of human tour guides. However, these systems add very little extra value to the visit compared to a tour with human guides. In fact, unlike with one-directional auditory playback system, having a human tour guide provides visitors' the additional opportunity to ask detailed questions in order to help visitors understand the exposition better in relation to their previous knowledge on the subject. A few projects (e.g. [1], [2], [7]) have been developing museum guides for mobile devices, but their main role so far has been to provide information in static multimedia format. Nevertheless, as we now know, the technology is ready to support visitors to immerse in the content displayed at the museum and to increase their interaction with the environment and other visitors. With this approach, the meaning and the purpose of any museum is enhanced. However, it is important to be aware that to develop proper applications towards this purpose, an interdisciplinary work between experts of different fields such as educational scientists, computers scientists, museum and content specialists, is needed.

The approach that we propose in this paper is to use pervasive mobile games to inspire, engage and motivate museum visitors. Games can be designed and used for a wide range of purposes: for individual entertainment [3], as a catalyst of social interaction [4], for teaching-learning [5], as an experimental platform for new technologies and design concepts [6], and for publicity campaigns, to name but a few. In addition, games present a wide range of genres, independently of their digital or non-digital nature. One of the novel categories of games is that of pervasive games in which the game world is extended to the surrounding environment. SciMyst [14] is a pervasive mobile game with multiplayer characteristics, developed originally for the annual science fair SciFest [13] held for first time in Joensuu, Finland, in March 2007. Players of SciMyst use their mobile devices to explore a real world game environment by solving intriguing *enigmas* related to the physical environment. Enigmas in SciMyst are different problems or puzzles for which the answers are found from within the environment.

This paper first introduces the concept and technical framework behind SciMyst and our experiences of launching the game at the SciFest 2007 science festival. We then discuss how pervasive game systems akin to SciMyst could be used in museums as exploratory extensions to engage the visitors in interacting with the environment. This discussion also considers potential technologies that could be used with SciMyst in museums.

THE SCIMYST CONCEPT

SciMyst is a pervasive mobile adventure game with multiplayer characteristics for supporting social interaction among the players. The game is targeted for all ages from juniors to seniors. As stated previously, SciMyst was first introduced to the public during SciFest 2007 where the game received much positive attention from the visitors. The purpose of the game is to engage and motivate the visitors to explore the exhibition contents in a novel, inspiring way. SciMyst players use their mobile devices to explore a real world game environment (i.e. the festival arena) by solving intriguing enigmas related to the surrounding objects and phenomena. There are several types of enigmas ranging from multiple-choice questions to take-a-picture

tasks in which the player must locate a certain object based on given description and take a picture of a tag attached to it. If the player needs help with solving an enigma, he/she can contact other players through the multiplayer feature of the game. The location of a player is determined by 2-dimensional barcode tags; when a player wishes to enter a new area (i.e. section at the festival), he/she must take a picture of the respective tag. The game has two modes: normal mode, which has no time constraint, and the battle mode, in which the player has to solve as many enigmas as possible in a limited time. The intention is that the player enters the battle after playing the normal mode.

Ages of the players at the SciFest ranged from approximately 8 to 60 years. In some cases we witnessed that a whole family or a group of friends played together as a team. Our experiences suggest that pervasive mobile games similar to SciMyst are suitable for players of all ages, providing that the content is appropriate. Figure 1 presents random game play situations during the SciFest 2007 festival.

Figure 1 SciMyst in action during SciFest 2007 festival

TECHNICAL FRAMEWORK OF SCIMYST

The technical framework of SciMyst can be divided into several parts. Additionally, each part is defined according to its role in the framework. The parts and their relations are presented in figure 2.

The **network** that enables the communication between the server, clients and the environment is established as a wireless network (e.g. WLAN, 3G, BlueTooth). In fact, the framework can utilise several wireless networks for different purposes. For example WLAN can be used for client-server communication while two clients can communicate through shorter range BlueTooth connectivity. The game is built upon free, open source, Java-based MUPE (Multi-User Publishing Environment) platform developed by Nokia. The MUPE platform consists of the server and one or more clients (i.e. mobile devices running the client software). The fundamental idea of MUPE is that the server pushes content to the client in special XML (eXtensible Markup Language) format, and the client renders the XML to show the corresponding user interface screen on the mobile device. Functionalities of the MUPE client can be extended easily by developing plug-ins.

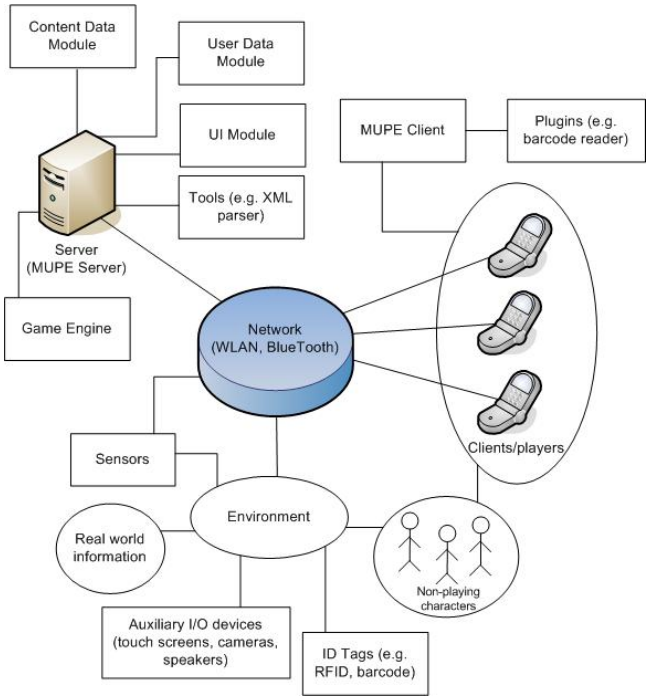

Figure 2 Parts and relations of the SciMyst framework

The **server** part of the framework consists of several modules, each having specific tasks to handle. For example, UI Module contains XML descriptions of user interfaces to be displayed on the **client** devices, and Content Data Module stores enigmas and other content related to the game play. It is easy, from the server management point of view, to change physical location of the game and create new enigmas as both location information and enigma data are presented in XML format. The flexible game engine provides tools for changing rules (e.g. time constraints, awarded points) of the game, if necessary.

The **environment** part of the framework, connects together auxiliary input/output devices, sensors, ID-tags, and real world information (e.g. objects, phenomena), which is used to solve the presented enigmas. In the current version of SciMyst, two-dimensional barcodes are used together with a barcode reader plug-in in the MUPE client for relocating players and identifying objects. RFID or any other tagging technology could be used for this purpose as well. Non-playing characters (NPCs) are other persons who are at the festival area (e.g. organisers, experts) but are not playing the game. NPCs can indirectly be involved in the game, if the players seek to interact with them during the game play. This interaction can occur for example when players ask NPCs for advice or help for solving an enigma or finding a specific location. This kind of ad-hoc social activity encourages the players to learn more about the topic at hand.

Sensor and positioning technologies, such as thermal, movement, tilt and acceleration sensors, and GPS (Global

Positioning System) can be used as components in the framework to establish novel ways to interact with the environment. This variety of interconnected elements creates a wide, multi-dimensional bridge between the virtual world and the real world.

SCIMYST FRAMEWORK IN MUSEUMS

In order to increase visitor engagement, inspiration and motivation in the context of museums, we propose the SciMyst technical framework be adjusted and deployed for museum environments. SciMyst utilizes the physical objects, phenomena and information available in the environment as an important element to immerse users in a flow of content. Museums contain precious amount of objects and information which offer fertile ground for interactive, inspiring applications. In principle, the physical environment of the SciFest is very similar to that of museums; both have distinguishable sections, each having several subsections (stands) for exhibitions of different topics. Furthermore, both arenas contain large numbers of interesting objects and phenomena for visitors to observe and interact with.

A clear invitation, from the research community, is to make use of museums in more immersive, interactive ways. In this paper, we use the following definition of interaction for museums:

> "A hands-on or interactive museum exhibit has clear educational objectives which encourage individuals or groups of people working together to understand real objects or phenomena through physical exploration which involves choice and initiative." [8]

This kind of interaction cannot be done by mere static multimedia content. If we consider SciMyst from the point of view of this definition, we can notice that the players are not necessarily touching objects or phenomena with their bare hands, but they do interact with them through the game, and through this process the players are immersing themselves in the content while the game play takes place. It is very easy to add physical interaction to the game, however, by introducing a new type of enigma, for instance a "try-it-enigma." This enigma, for example, might ask users to try to use a replication of an ancient tool. Social interaction is already present in SciMyst as a form of the multiplayer feature, but it can be enhanced by introducing special team-enigmas which cannot be solved by a single player alone.

How do ubiquitous systems and computers in general fit to museum environments (which usually have an ancient atmosphere)? Hawkey [9] argues that computers (and technology in general) actually complement the old objects as "boring", old objects can be brought to life through computers and technology. In addition to providing added value and alternative means of content delivery, novel technologies in museums can allow visitors to experience the surrounding content in an innovative way. The player can take, for example, a role of a medieval knight or a farmer. By establishing a pervasive system in which computing devices are connected to physical objects within the environment, we can establish a firm connection between the real world and the virtual world. In this new merged world the number of interaction channels is multiplied, thus forming a fruitful playground for informal learning.

TECHNICAL ASPECTS OF SCIMYST FOR MUSEUMS

The current technological status of SciMyst is merely a starting point towards a system utilising highly intelligent and interactive environments. To achieve such a responsive environment, we need inter-disciplinary co-operation including research fields such as software engineering, machine vision, pattern recognition, intelligent agents, natural language processing, speech recognition, multimedia, networking, sensor technologies and mobile technologies. Table 2 lists some of the promising technologies together with their proposed usage in SciMyst framework for museums. These technologies may be applicable to any other environment where SciMyst framework is implemented.

Table 1. Promising technologies for the SciMyst technical framework in Museums

Technology	Examples of usage for SciMyst in museums
Advanced displays	3D displays can be used to visualise any objects or phenomena that are not visible to human eye or that are not in their original form. Types of 3D displays that can be used are for example autostereoscopic [15] and holographic [16] displays. Fog screens [17] are suitable for creating walk-through interactive displays.
RFID tags and readers	This tagging technology is useful for identifying players' location or for providing on-demand information of objects and phenomena. It can also be used in many game play features; for example, a player could use RFID reader to collect "keys" for virtual locks.
Speech/ voice recognition	Speech and voice recognition can be used for example in player identification, voice commands, or communication with virtual characters. Furthermore, the game can have a feature in which the players practise speaking old languages, imitate extinct animals, or perform some other auditory tasks.
Augmented reality tools	Software akin to AKToolKit [10] can be used to augment reality with 3D objects, viewed through a camera lens. In museums or historical sites this technique could be used to create a complete view of how things used to look like. This technology can be used in SciMyst, for example, to find hidden objects that are only viewable through the mobile device's camera.
GPS positioning	GPS can be used for accurate positioning of players and other objects in the museum context. Positioning is feasible both indoor and outdoor museums with appropriate chips embedded in the devices.

Movement-based sensors	As used in Nintendo Wii game controller, acceleration and optical sensors can be used to create physical control mechanism; the player could do things like use the mobile device to swing a virtual sword as a medieval knight. Other useful movement-based sensors that enable various kinds of physical activities include for example tilt, vibration, shock, pressure, and proximity sensors.
Environment sensors	These sensors detect changes in the environment, including: thermal, distance, sound, infrared ray, illumination, and humidity sensors. In the SciMyst framework for museums these sensors can be used for example to adjust the game behaviour according to environmental changes.
Haptic user interfaces	Of haptic user interfaces, touch screens have been already introduced in many museums. Other systems include pressure plates (e.g. walls, floors), force feedback and vibration feedback. In the SciMyst framework, touch screens, for example, can be used to implement features that require too much screen real estate to be fit on a mobile screen. Haptic UI technologies can be used in museums to enable virtual hands-on experiences.
Smell technologies	Smell-O-Vision [18] and smell sensors can be used for effects regarding sense of smell. In museum environment this may be used when a visitor enters an old room, he can smell the space as it used to be, as one example.
Miniature projector	The screen real estate problem of mobile devices can be tackled by tiny projectors which are embedded inside the mobile device. For example, PicoP projector [15] can project a widescreen image of 853x480 pixels. In the SciMyst framework for museums, miniature projectors can be used to view in-game content (videos, image) in a more pleasant manner.

For museum environments we propose several game modes to be developed. This is because there are visitors with different preferences both in terms of content and game experience. For example, an older visitor might prefer a calmer game play with deep content challenges, while a child probably looks for exciting and active game experience where new knowledge is presented indirectly. Adaptive intelligence of the User Data Module of SciMyst Framework could also be developed to learn from players' behaviour and thus adapt better for their needs.

Pervasive systems utilising technologies described above are not far in the future. Furthermore, soon we will not speak of augmented reality anymore, but of merged reality instead. In the context of museums this means that a visitor can experience life of the past, much as it used to be, or in the future, as it might be. When this happens, museums may transform into virtual time travel agencies, allowing visitors to take a roles of people in the past or future and thus learn through engaging experiences.

CONCLUSIONS

We presented the SciMyst concept together with the technical framework on which the system is built. Applicability of SciMyst framework for museums as an exploratory extension was discussed and potential technologies reviewed. By using the presented technologies in the SciMyst framework, it is possible to create a highly interactive and immersive system for museums where visitors can experience the content in a novel way. Social interaction among players and non-playing characters is also present in the SciMyst concept.

For future work we intend to continue development, testing and evaluating SciMyst in order to add more features and support a large variety of sensors and technologies presented in this paper. Furthermore, we will seek to measure and improve the influence and acceptance of SciMyst among different types of users. To achieve the aforementioned goals, we will establish collaboration projects with professionals across related disciplines.

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