ELEMENTS IN GAMES FOR VIRTUAL HERITAGE APPLICATIONS

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Abstract

The methods of preserving cultural heritage are becoming increasingly digital, and with this development it is becoming all the more open to public scrutiny. The field of virtual heritage and their applications, which digitally preserve cultural heritage using virtual reality, are struggling to live up to the expectations of the public. The virtual heritage field has begun to look for solutions to their problems in other fields, such as that of video games. This thesis identifies 17 elements which are sought after for incorporation in virtual heritage applications, by conducting a literature review of recent virtual heritage research and organizing the findings into a matrix. The occurrence of the identified elements in four different modern entertainment video games is further analyzed and described. The resulted element matrix and game reviews could be used in the future development of virtual heritage applications, and of cultural heritage or historical video games.

**Key words:** cultural heritage, virtual heritage, video games
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1 Introduction

The Mona Lisa (Figure 1). Or should I say Lisa Gherardini? That is who the woman in the drawing is believed to be, a simple wife of a cloth merchant called Francesco del Giocondo from Florence, Italy (Scailliérez, 2007). But today she is so much more. Her portrait is claimed by some to be “the one painting everyone knows” (Sassoon, 2001, p.124). Others say it is “the best known, the most visited, the most written about, the most sung about, the most parodied work of art in the world” (Lichfield, 2005). That is not bad for a piece which originated a whole five centuries ago, although be it made by the famous Leonardo Da Vinci (Scailliérez, 2007). It is a grand example of what cultural heritage the Western world has to offer, but it is far from the only example. Cultural heritage in general is revered throughout the world, and as such the various attempts aiming to keep it protected from the tests of time continue.

In today’s modern era, cultural heritage is increasingly preserved using methods of digitalization. A lot of pressure is put on the representation of the digitalized material as it becomes available to the scrutiny of the public at cultural heritage sites, museums, and schools, to name a few. One field which is putting much thought into the representation specifically is the field of virtual heritage, which spawned out of the combination of flashy virtual reality and serious cultural heritage. By making virtual heritage applications with cultural heritage sites recreated into interactive 3D worlds they attempt to attract the interest of the public (Ibrahim et al, 2011; Jacobsen and Holden, 2007; Roussou, 2002). But unfortunately, virtual heritage is not living up to the public’s expectations (Sanders, 2001). In an attempt to further the development of virtual heritage, and to correct some of its wrongs, some have begun to look toward the field of video games as a possible source of inspiration (e.g. Anderson et al, 2010; Champion, 2006; Flynn, 2007; Lucey-Roper, 2006; Sanders, 2001). This study follows their queue.

In order to figure out whether games can be used to shed light on possibilities for virtual heritage applications, whether and in what way elements which are sought after for incorporation in virtual heritage applications can be found in modern entertainment video games is investigated in this study. First a systematic literature review of recent virtual heritage research is conducted in order to establish which elements are in fact sought after for incorporation in virtual heritage applications. Thereafter a search for entertainment
video games containing these elements is made. The games are examined and analyzed and the ways in which the elements occur in the games are described, so as to provide illustrative examples for the virtual heritage field of what possibilities exist for their virtual heritage applications.
2 Background

The following chapter provides a brief background of cultural heritage, and its digitalization. Two different types of digital realities, virtual and augmented, which for instance are used for showing digitalized cultural heritage, are presented. Further on, the virtual heritage field, which combined from virtual reality and cultural heritage, as well as its relation to the field of video games, is introduced.

2.1 Cultural heritage

Traditionally, what has been referred to as cultural heritage, or sometimes just heritage, is what is now defined as tangible cultural heritage. Tangible cultural heritage can for instance refer to paintings, sculptures, monuments, individual and groups of buildings, as well as sites containing works of man. It can also refer to natural matters, sometimes referred to as natural heritage, such as natural features and sites, as well as geological and physiographical formations (UNESCO, 1972). Recently, intangible matters have gained an increasing amount of interest, and are generally now also included in the term cultural heritage. Intangible cultural heritage can for instance refer to practices, representations, expressions, rituals, traditions, events, knowledge, and skills (UNESCO, 2003a). Worth noting is that matters whose original form is digital, e.g. websites, movies, and games, can also be referred to as heritage. However, these are usually referred to as digital heritage (UNESCO, 2003b).

There exists no complete uniformity between definitions of the term cultural heritage posed by neither individuals nor organizations or countries (Harvey, 2001; Ahmad, 2006). Although, it is clear that cultural heritage can refer to a vast range of matters. What both of tangible and intangible matters have in common is most obviously that they originate from a past time, whether distant or recent is not important. What ultimately defines these matters as cultural heritage, however, is that they are considered significant and thus important to be maintained and preserved for current and future generations.

2.1.1 Digitalization of cultural heritage

Compared to traditional conservation of tangible cultural heritage, digital recording of cultural heritage matters is a new form of preservation, typical to the digital society we live in today. Museums, archives, libraries, and galleries are extending their operations by creating digital collections of cultural heritage material, such as paintings, books, music, and movies. Even sculptures, monuments, buildings, and whole sites have been scanned and transformed into digital 3D versions (Tonta, 2008). These are made viewable in so called digital libraries, utilizing the type of search and browse interaction typical to library databases. Not only does this digital recreation of cultural heritage help to preserve it, but it also significantly increases their accessibility (Abdul Karim, 2004; Tonta, 2008). The public presentation of digitalized cultural heritage matters is further expanded by the relatively new field called virtual heritage.

2.2 Virtual and augmented reality

Although head-mounted displays, headphones, and haptic devices like motion-sensing gloves are not required for virtual reality to be defined as such, the virtual reality field is typically known for its usage of just that, in combination with highly advanced technology. By simulating sensorially rich entirely virtual environments and providing a high degree of
navigability and interactivity, virtual reality systems have attempted to convey to the users a sense of “being there”, although the users actually are not (Steuer, 1992).

Augmented reality can be described as the middle ground between virtual reality, which is entirely simulated, and reality, which is entirely real. In a sense, augmented reality is the addition of virtual reality to reality (Azuma, 1997). An example of when augmented reality applications can be used in relation to cultural heritage is during a visit to a historical building. By using an augmented reality application installed on the visitor’s smartphone, s/he can view the building as it appeared way back in history superimposed on the view of the building from their smartphone’s camera (Figure 2).

![Figure 2 Mobile augmented reality application (Fraunhofer Institut, 2009)](image)

### 2.3 Virtual heritage

From the combination of virtual reality and cultural heritage, a field now known as virtual heritage has arisen. Originally the field of virtual heritage was focused on recreating tangible cultural heritage by making realistic 3D models depicting them. These models could either be a direct recreation of a specific cultural heritage entity or a representation of how an entity may have appeared in the past (Ibrahim et al, 2011; Jacobsen and Holden, 2007; Roussou, 2002). The models would be featured in specifically tailored digital applications, as part of larger virtual environments and sometimes also as standalone pieces. Some applications made for internal research purposes, such as testing or simulating different conditions, would never go on to be presented to the public.

Many virtual heritage applications, even today, do not offer the users any way to interact with the presented material (Champion, 2008), those that do generally merely allow the users to use spatial navigation to tour through a virtual environment (Roussou, 2006). However, even the tours are sometimes limited to interaction both decided and executed by the staff of the organization providing the application (Economou and Pujol Tost, 2009). Some researchers and practitioners in the field of virtual heritage agree that this is far from optimal, that the degree of interactivity allowed for the public is too low and offers too little variation (e.g. Champion, 2002; Economou and Pujol Tost, 2009; Flynn, 2007; Roussou, 2006; Sanders, 2001).
Another problem which some practitioners and researchers within the field of virtual heritage has identified is the narrow focus on technology and graphics in contrast to the little attention which is being paid to the intangible elements of cultural heritage. They suggest the need to incorporate intangible heritage in the further development of virtual heritage applications; to turn from simple recreation of artifacts, buildings, and environments, toward the simulation of cultures and cultural expressions connected to them (e.g. Affleck and Kvan, 2005; Champion, 2002; Ibrahim et al, 2011; Jacobsen and Holden, 2007; Roussou, 2002). So far, the attempts made have usually been limited to the addition of characters, either or both interactive and not, to the traditional virtual recreations of tangible environments (Jacobsen and Holden, 2007; Roussou, 2002).

2.3.1 Turning to video games
As some problematic elements, like low interactivity and lack of intangible matters, have been identified in virtual heritage applications in general, some of those working in the field of virtual heritage have begun to look at other fields for inspiration and solutions. One such field is the field of video games, which on the technical side is not too different from the virtual reality based field of virtual heritage. Although video games and virtual heritage applications possess similarities, the two fields have largely developed separately. While virtual reality systems, like virtual heritage applications, in many cases have been confined for use in research and industry labs (Roussou, 2002), the target audience of video games has essentially always been the public.

The narrow focus on recreation of visuals in the virtual heritage field has led to a lack of quality and relevance in regard to meaningful content. Instead of presenting static 3D environments, experiences of virtual time portals with dynamic historical worlds should be provided. But as of yet the virtual heritage field does not offer that possibility, and due to this the public’s expectations are not being met (Sanders, 2001). All the while, video games have continued to gain in popularity, especially amongst the young (Lucey-Roper, 2006). So it seems that the curiosity which the virtual heritage field possesses for the design of video games is well-founded. Especially since the technology of modern entertainment video games has also been deemed to possess the possibility of having more advanced virtual recreations and simulations of cultural heritage, combined with a greater amount of interactivity than traditional virtual heritage applications, while still being able to run on fairly low-performance machines (Anderson et al, 2010; Champion, 2006).
3 Problem statement

Researchers and practitioners within the field of virtual heritage have taken notice of various elements which too often occur, and some which do not occur enough, within virtual heritage applications. The problems often noted include for instance low degree of interactivity (e.g. Champion, 2002; Economou and Pujol Tost, 2009; Flynn, 2007; Roussou, 2006; Sanders, 2001) and lack of intangible heritage (e.g. Affleck and Kvan, 2005; Champion, 2002; Ibrahim et al, 2011; Jacobsen and Holden, 2007; Roussou, 2002). While aiming toward mitigating these problems, some have suggested that suitable inspiration may be possible to find within the field of video games (e.g. Anderson et al, 2010; Champion, 2006; Flynn, 2007; Lucey-Roper, 2006; Sanders, 2001).

In accordance with the suggestions from researchers and practitioners in the virtual heritage field, as mentioned above, the aim of this study is to investigate whether and in what way there are elements in video games which could in fact be used as inspiration for the further development of virtual heritage applications. This is done by developing a list of elements which, according to researchers in the field, are sought after for incorporation in virtual heritage applications. By making such a list, gaining a better understanding of the purpose of virtual heritage applications is made easier, not only for the author, but also the readers of this study. By using the list as reference, the different elements’ occurrence in different modern entertainment video games is examined and analyzed, in order to provide relevant examples of possibilities and inspiration for the virtual heritage field.

The questions which this study aims to answer are summarized in a specific problem statement.

“In what ways can elements which are indicated as sought after for incorporation in virtual heritage applications, according to recent virtual heritage research, occur in various modern entertainment video games?”

This question is broken down, and organized into sub-questions. These are further made clearer by posing equivalent questions in a more informal manner, as imagined to be asked by the virtual heritage field.

“In what way should the term ‘virtual heritage application’ be conceptualized regarding definition and purpose, for this study?” – “What is this about?”

“What elements are indicated as sought after for incorporation in virtual heritage applications, according to recent virtual heritage research?” – “What do we want?”

“What modern entertainment video games are relevant to investigate for the development of virtual heritage applications?” – “Can what we want be found in games?”

“In what ways can elements which are indicated as sought after for incorporation in virtual heritage applications occur in various modern entertainment video games?” – “What kind of examples do games have of what we want?”

The purpose of answering these questions, the purpose of this study, is to provide examples of and shed light on possibilities for virtual heritage applications. The findings provide a starting point which ought to be considered by those working in the virtual heritage field as they further develop virtual heritage applications.


3.1 Literature review method

3.1.1 What is this about?

“In what way should the term ‘virtual heritage application’ be conceptualized regarding definition and purpose, for this study?”

Defining the term ‘virtual heritage application’ according to the way it is to be interpreted in this study is necessary in order to diminish the possibility for misunderstandings regarding this particular matter, for everyone concerned. During preliminary research it was found that no clear agreed upon definition existed, so instead it was deemed appropriate to suggest a working definition for this study. The working definition is developed to provide a type of baseline, i.e. a point of reference including the most basic features of all types of virtual heritage applications, which at the core distinguish them from other types of applications. Also taken into consideration is the possibility for comparison of the definition in this study with a general definition of entertainment video games.

3.1.2 What do we want?

“What elements are indicated as sought after for incorporation in virtual heritage applications, according to recent virtual heritage research?”

By examining recent virtual heritage research it is possible to find movements, opinions and indications which are relevant to the present state of the virtual heritage field. In this case the used term ‘recent research’ has, simply out of convenience, been regarded as equal to research published between the year 2000 and present date, i.e. March 2013. The investigation of recent virtual heritage research is conducted in the form of a systematic literature review. Major contributions to the source material of a review article can generally be assumed to best be found in leading journals (Webster & Watson, 2002). Therefore, in accordance with the time and resource constraints of this study, journal articles discussing virtual heritage or virtual heritage applications make up the sole material used for this literature review. The result of the review is developed into a list of elements which according to the virtual heritage field are sought after for incorporation in virtual heritage applications. The list then goes on to be used for reference when examining modern entertainment video games.

The first part of the literature review involves gathering relevant articles using the online databases IEEE Xplore Digital Library, ScienceDirect, ACM Digital Library, SpringerLink and Taylor & Francis Online. These databases were chosen for their relevance to the subject of investigation, and because of their accessibility to the author. Through them access is gained to for instance The International Journal of Heritage Studies, Journal on Computing and Cultural Heritage, Journal of Cultural Heritage, Virtual Systems and Multimedia, as well as several other relevant sources. All findings are looked over informally in order to eliminate irrelevant material before commencing any deeper analysis. Some articles are eliminated after reading only the title, though most require studying the abstract, and others need even deeper consideration to determine their relevance. Articles discussing virtual heritage or virtual heritage applications are those which are of interest to this study.

Once the relevant articles have been gathered they undergo content analysis according to an analysis method comparable to that which Patton (1990) refers to as ‘inductive analysis’, or Hsieh and Shannon (2005) as ‘conventional content analysis’. First, each article is read through, and sections relevant to the research questions are highlighted. Initial notes are
also made in the margins. This process is then repeated for each article, the number of times depending on the article’s complexity. Preliminary codes for elements are developed for each article, and for each successive article the codes are re-worked if necessary. They then go on to be organized into a so called ‘concept matrix’ (Webster & Watson, 2002), further referred to as the ‘element matrix’. After all of the articles have been analyzed, the codes are reviewed, edited and organized one final time.

3.2 Game element review method

3.2.1 Can what we want be found in games?

“What modern entertainment video games are relevant to investigate for the development of virtual heritage applications?”

Before drawing conclusions about the main problem statement, the next step is to select what modern entertainment video games to target. ‘Modern entertainment video games’ has in this case been regarded as equal to entertainment video games released between the year 2000 and March 2013, in order to be as fairly comparable to the recent virtual heritage research previously examined. Purposeful sampling, more specifically criterion sampling (Patton, 1990), is used for the selection of games, based on the final element matrix completed in the previous step. So, for instance, if a code in the element matrix indicates that cultural expressions are sought after for incorporation in virtual heritage applications, a game containing such cultural expressions is selected. Other factors, such as the games’ popularity and critical acclaim, regarding the element(s) in question, are also considered in the selection process. The definitions and descriptions of elements in the element matrix combined with the author’s experience of video game terminology provides a starting point for the search for games, which is conducted informally using Google. Before making a final selection, however, further information necessary to make an informed decision about which games to examine is gone over. Official records about the games from their developer and publisher, as well as information from the leading video game news and reviews sites IGN and Gamespot, provide further basis for the selection.

3.2.2 What kind of examples do games have of what we want?

“In what ways can elements which are indicated as sought after for incorporation in virtual heritage applications occur in various modern entertainment video games?”

Once the literature review and the selection of video games have been completed, it is time to conclude the main problem statement. The elements which have been recognized in the selected modern entertainment video games are examined thoroughly and analyzed. The games are played, if possible, and notes are taken down regarding the specific element in question. If a particular game is not available to be played, play-throughs of the game found on the video-sharing website YouTube are viewed instead. Online descriptions and reviews of the games, as mentioned under the previous heading, are also examined in regard to the element in question, and taken into account. Special regard is taken to what features of the elements found in the selected games would be most rewarding for the virtual heritage field to learn about. These features become the focus of the descriptions of the elements in the reviews.
4 Literature review

4.1 What is this about?

“In what way should the term ‘virtual heritage application’ be conceptualized regarding definition and purpose, for this study?”

Virtual heritage applications contain navigable virtual heritage 3D environments – this is true for all types of virtual heritage applications. But not all types of virtual heritage applications have the same purpose and intended users. For instance, there are virtual heritage applications used internally by groups of researchers for studying simulations of different conditions. But there are also virtual heritage applications used by museum goers to visit lost historical locations. To diminish the possibility of misunderstandings regarding what type of virtual heritage application is investigated in this study it is necessary to establish a clear working definition. In an effort to be able to draw as clearly relevant conclusions as possible about the findings of this study, it is best to keep the working definition basic and explicit, to contain those features of the type of virtual heritage application researched in this study which are most essential to its core.

By keeping to subjects of investigation whose definitions are similar at their core, they can be assumed to be fair to judge by similar criteria, i.e. to be comparable. Therefore, the type of virtual heritage application most relevant to investigate for this study is the type which is closest in definition to that of an entertainment game, and vice versa. The most fundamental purpose of entertainment video games is, as the name implies, to entertain. Different entertainment video games have different core target audiences, but in a general sense the target audience is the general public. The types of virtual heritage applications relevant to this study are therefore those whose purpose is to gain the interest of the general public.

While virtual heritage, although it stems from the use of virtual reality for cultural heritage purposes, sometimes also includes references to applications using augmented reality, this is not the case in this study. The difference in form of simulation used in virtual reality applications and augmented reality applications is great enough to be assumed to affect the elements within them.

Finally, by piecing together the discussed characteristics for ‘virtual heritage application’, its working definition for this study becomes as such:

“Virtual heritage applications use virtual reality to simulate virtual heritage 3D environments, and aim to gain the interest of the general public.”

4.2 What do we want?

“What elements are indicated as sought after for incorporation in virtual heritage applications, according to recent virtual heritage research?”

In order to find out what elements are sought after for incorporation in virtual heritage applications the decision has been made to conduct a systematic literature review of journal articles on the subject virtual heritage. By performing a content analysis on the gathered material, specific opinions and indications about which elements are sought after can be found. These then go on to be sorted into a matrix of elements, which is to provide a source which is clear and easy to refer back to later on in the study.
The search for journal articles was made based on the term ‘virtual heritage’. A search for articles with an abstract containing both the words ‘virtual’ and ‘heritage’, or variations of these, e.g. ‘virtualized’, received approximately 250 hits over the different online databases used. Out of these 250, 22 were selected for further review. The vast majority of the articles not selected were technological studies, most of them regarding techniques, software, or hardware used for 3D digitalization of cultural heritage objects or sites (e.g. Blais and Beraldin, 2006; El-Hakim et al, 2004; Guidi et al, 2006; Sansoni and Docchio, 2005; Styliadis and Sechidis, 2011). These articles do not go on to be reviewed since the technology behind the virtual heritage applications is not what is under investigation in this study, but the elements within the application itself. However, it is clear when considering the sheer amount of articles on the subject that visual accuracy is very important to the virtual heritage field. This is therefore to be duly noted in the element matrix. Other articles which were not selected for the literature review were about digital heritage, digital libraries, augmented reality, or completely unrelated matters. Very few were found to be almost completely unrelated, but those were of course also excluded.

4.2.1 Analysis

To get a general basis for analysis, the 22 articles selected for further review were divided into two groups. One group consisted of review and conceptual articles, while the other group consisted of original research and case studies. The reason for this division is that the types of articles in the different groups represent the authors’ assumed knowledge of the subjects discussed within them. Authors of original research or case studies can be assumed to have detailed knowledge about the cause and effect of a choice made to incorporate a specific element in the virtual heritage application presented in their article. Thus, if they present that a specific element was incorporated into the virtual heritage application it would be logical to assume that, according to them, the element is sought after for incorporation. That is, unless they expressly presented the element in a manner that suggests otherwise. Authors of review or conceptual articles, however, discuss research originally made by others in a more broad sense. They discuss others’ research, e.g. original research or case studies, and while they can make assumptions about the cause and effect of a choice made by these others to incorporate a specific element in a virtual heritage application, they can only truly know why that choice was made if that has been presented to them.

In a general sense, the elements discussed in the review and conceptual articles group were assumed to be sought after if presented in a positive manner or context. The elements discussed in the original research and case studies group were generally assumed to be sought after as long as they were not presented in a negative manner. Despite the separation into two groups, however, all articles still went through extensive reading and analyzing. Elements were derived from meaning and context, and sorted into the element matrix. For each article read, the matrix was expanded, and the elements were resorted according to their contents and meanings. During this process, four of the selected articles were excluded from the final cut due to their lack of relation, or to their technological approach. Thus, the review and conceptual articles group finally consisted of 8 articles, while the original research and case studies group consisted of 10 (Table 1).
Table 1 Final grouping of articles selected for review

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<tr>
<th>Review and conceptual articles</th>
<th>Original research and case studies</th>
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<td>Stone, R. et al. (2009)</td>
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<td>Wang, X. et al. (2009)</td>
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Worth noting is that the degree to which an element is sought after in relation to its possible impact on hardware performance has not been taken into account for this study. When developing any type of digital application one must always consider the impact on hardware performance, but no distinction as to what type of hardware would be feasible or practical to use for the running of virtual heritage applications is relevant to be made in this study. As previously mentioned, it is not the technology behind the virtual heritage applications which is investigated in this study, only the elements within them. The only distinction which could be relevant to make in this article is that the element should be technically possible. If for instance an element identified involves giant elephants which can walk straight out of the digital computer screen and into the real world, that element is not technically possible. No elements found to be sought after according to this review needed to be excluded because they are technically impossible, however.
5 Element matrix

The element matrix has been developed to consist of five key categories entitled ‘Interactivity’, ‘Meaning’, ‘Player character’, ‘Other characters’, and finally ‘Accuracy and realism’. Some of these are basic elements, while others are simply descriptive denominations, but they each contain various sub-elements.

When possible, the elements have been entitled according to their typical counterpart in video game terminology, in order to be as easily identifiable in the game reviews which follow. For instance, in virtual heritage the person using an application is typically called the ‘user’, but in video games, and thus also in the titles of this matrix, the ‘user’ is instead called the ‘player’.

5.1 Interactivity

The element of interactivity can in the case of digital applications essentially be described as the ability to affect, use or communicate with something or someone in a digital or virtual environment. In virtual heritage applications it can for instance refer to the ability to perform tasks by using objects in the environment or to partake in a dialogue with a virtual character.

In 2007, Jacobsen and Holden wrote that “…communication is oneway in the sense that the ancients are dead and cannot ask or answer questions, but we can learn about them by interacting with simulations of them and their environs.” (p.57). Champion had a similar conviction, when in 2008 he wrote; “…I suggest that a primary aim of virtual heritage is to communicate the cultural significance of a site. One powerful way to do this is via interaction.” (p.212). Neither of them are far from alone in their interest to use the element interactivity for virtual heritage, however (Anderson et al, 2010; Bellotti et al, 2012; Ch’ng, 2009; Champion et al, 2012; Chen et al, 2010; Chen et al, 2013; Cunningham, 2010; Cruz-Neira, 2003; Gabellone, 2009; Hirayu et al, 2000; Pujol and Champion, 2012; Stone et al, 2009; Wang et al, 2009).

5.1.1 Exploration

Exploration could be referred to as the most basic form of interactivity. It is directly related to the degree to which an environment is openly navigable, i.e. the amount of exploration an environment allows. A virtual heritage application containing an environment which consists of a large degree of explorable areas is more interactive than an environment which consists of only a few barely navigable spaces. According to Pujol and Champion “Virtual environments should be designed and evaluated according to their capacity for providing opportunities for exploration…” (2012, p.98). Several other authors also see exploration as a positive addition to virtual heritage applications (Bellotti et al, 2012; Champion et al, 2012; Jacobsen and Holden, 2007).

5.1.2 Tasks

In 2012, Bellotti et al. described tasks as “…activities characterized by the ability to engage the learner’s interest; a primary focus on meaning; a need for completion; an outcome in terms of which success is judged; and a clear relationship with real-world activities.” (p.17:3). They suggested that the element of tasks was particularly suited for cultural heritage entertainment applications. Many other articles present wants for the incorporation of tasks
in virtual heritage applications as well (Anderson et al, 2010; Ch'ng, 2009; Champion, 2008; Champion et al, 2012; Chen et al, 2010; Hirayu et al, 2000; Wang et al, 2009).

There are many types of tasks which could be, and sometimes are, used in virtual heritage applications. For instance Ch'ng suggests that “A hunter-gatherer scenario could be set up so that virtual weapons and tools are used for hunting and gathering food from pre-programmed virtual animals, plants, and seafood.” (2009, p.467). In 2010, Chen et al. described a part of their virtual recreation of the Jing-Hang Grand Canal, China; “Users can expediently improve their knowledge of the history and science related to the canal by virtually performing actions, such as shipping grain, that existed only in ancient times.” (p.85). In video games it is typical to incorporate tasks which involve killing, gathering, delivering, escorting, exploring, or puzzle solving. In some video games, mostly in role-playing games, there are so called quests. These can be simple tasks in themselves, but they can also consist of several consecutive or combined tasks or challenges which must be done in order to complete the quest.

5.1.3 Dialogue
Dialogue is the verbal communication between two or more people, or in virtual heritage applications typically between the player and a non-player character (NPC), i.e. an artificially intelligent or otherwise pre-programmed virtual character which is not controlled by the player. Dialogue of this type can for instance consist of the player choosing between a number of topics or phrases. Each option provided has a predefined response from the NPC connected to it, which is displayed upon selection of the correlated option. A number of articles mention dialogue as an element of interest for use in virtual heritage applications (Blake and Ladeira, 2011; Champion et al, 2012; Cruz-Neira, 2003; Jacobsen and Holden, 2007).

5.1.4 Quiz
Bellotti et al. (2012) present quizzes as an element for incorporation in virtual heritage applications. They suggest quizzes can be a way for players to learn about cultural heritage using virtual heritage applications. This could be compared to the way students can learn from doing tests in school. In the same article an application is presented in which “By executing the task, the user can virtually manipulate pieces of the artistic heritage and answer quizzes on the history, art and culture of the PoI [Point of Interest].” (Bellotti et al, 2012, p.17:12). They present much variation to their quizzes, in which they use images, text and various forms of submitting answers.

5.2 Meaning
As bears mentioning at least once more, the virtual heritage field has in the past been preoccupied with the recreation of tangible heritage for their applications. However, now they are gaining greater interest for elements which can add a greater sense of meaning to their applications.

5.2.1 Culture and history
One of the most sought after elements for incorporation in virtual heritage applications, at least according to the sheer amount of articles referencing it, is that of culture and history, or intangible heritage, if you prefer (Anderson et al, 2010; Bellotti et al, 2012; Blake and Ladeira, 2011; Champion, 2008; Champion et al, 2012; Chen et al, 2010; Chen et al, 2013;
The virtual heritage field has always put a great amount of work into the recreation of tangible heritage, but as Pujol and Champion express it “Fortunately, the field is now taking increasingly into consideration the meanings, purposes or processes behind physical elements…” (2012, p.84). They also write that “Unlike the test environments of typical presence research, virtual heritage projects should not aim at the fidelity of representation of the world in general, but towards a cultural context, containing not only objects and active agents but also the inter-relationship of their situated beliefs and values.” (Pujol and Champion, 2012, p.89). These are matters which the element of culture and history entails. Cultural expressions like rituals, traditions, customs and beliefs all belong to it. Anderson et al. have written that “…a historical setting is enriched with information about important events and developments that occurred during the timeframe experienced…” (2010, p.260). These historical events and developments also belong to this element.

How this broad element is represented in a virtual heritage application depends very much on the time, place, and people which the application attempts to simulate. As Ott and Pozzi have written; “…the study of an artist and of her works may entail not only the study of their main artistic features, but also the study of the civilization where she lived, the socio-cultural conditions at that time, the links with others populations, cultures and artists, etc.” (2011, p.1368).

5.2.2 Story
One way to for instance depict the previous element, culture and history, in a virtual heritage application is through the use of a story. Through the use of an interactive narrative, the player can experience historical developments via the progression of a story, beginning at a certain point in time and ending at another. In video games, it is common that the player learns what her/his purpose or goal is in the game quite early on. Then, by exploring, performing tasks, and communicating with NPC’s the story progresses, and the player moves closer to the goal, i.e. the end of story. Along the way, the player often learns more about the world s/he is in, the people around her/him and her/his connection to them, as well. Several articles present story as a possible positive addition to virtual heritage applications (Ch’ng, 2009; Chen et al, 2013; Cunningham, 2010; Cruz-Neira, 2003).

5.3 Player character
5.3.1 Roleplay
Virtual heritage applications can present a unique opportunity for players to experience a historical environment while playing as a character belonging to that environment. “Using VR in computational humanities opens up the possibility of time and space travel, letting people actively participate in the story being told, experience the events firsthand, and interact with (or even become one of) the environment’s characters.” (Cruz-Neira, 2003, p.10). “Imagine a Roman history class in which students [get to] experience being Roman citizens…” (Cruz-Neira, 2003, p.11), or perhaps an Egyptian peasant in Ancient Egypt (Jacobsen and Holden, 2007). Several articles present the element of roleplay as a positive addition to virtual heritage applications (Ch’ng, 2009; Cruz-Neira, 2003; Jacobsen and Holden, 2007).
5.3.2 Avatar
The player character’s avatar is the visual equivalent of the player in the virtual environment. In virtual heritage applications the avatar is typically a 3D model of a human which has been designed to either match the application’s setting, or to represent or otherwise appeal to the intended players. In these applications the player can usually interactively move and use the avatar in different ways in the virtual environment. Many articles refer positively to using this element in virtual heritage applications (Blake and Ladeira, 2011; Bellotti et al, 2012; Ch’ng, 2009; Champion, 2008; Chen et al, 2013; Cruz-Neira, 2003; Cunningham, 2010; Jacobsen and Holden, 2007).

5.3.3 Personalized avatar
In 2013, Chen et al. suggested that the use of a personalized 3D avatar for players in their virtual heritage application could enhance user immersion. In the application they created they allowed players to personalize their character using a photo of themselves. Using a camera on location, they photographed the player’s face, implemented the photo into the application and applied the photo on a 3D model (Figure 4). In video games it is often possible to personalize the player’s avatar by choosing gender, body type, facial features, hairstyle, clothing, etc.

![Figure 3 Process of creating a personalized avatar (Chen et al, 2013)](image)

5.4 Other characters
In certain types of digital applications it may be beneficiary to incorporate virtual characters other than the player’s character into the virtual environment. Many agree that this is also the case for virtual heritage applications (Anderson et al, 2010; Blake and Ladeira, 2011; Bellotti et al, 2012; Ch’ng, 2009; Champion et al, 2012; Chen et al, 2010; Chen et al, 2013; Cruz-Neira, 2003; Jacobsen and Holden, 2007; Pujol and Champion, 2012). In 2012, Pujol and Champion wrote specifically that “It is likely that cultural presence would be improved if virtual heritage applications contained real and virtual (inter)active inhabitants.” (p.90). As they propose, the inhabitants of a virtual heritage application environment may be either virtual, i.e. controlled via pre-programming, or real, i.e. controlled by other players.

5.4.1 Multiplayer
Video games which can be played by multiple people in the same game environment at the same time are called multiplayer games. Multiplayer games take many different forms. Some allow co-operation between players, and some allow them to challenge and play against one another. There are also various degrees of multiplayer, stretching from only two players, up to so called massively multiplayer online games (MMOs) which can allow hundreds or thousands of players to populate the same environment at the same time.
In 2007, Jacobsen and Holden wrote “One very effective way to use VR to teach students about ancient culture is to have them enter the virtual environment as a shared social space and have them role-play members of that society.” (p.58). Incorporating the element of multiplayer in virtual heritage applications can allow that. Several other authors think that this element is interesting for use in virtual heritage applications as well (Ch'ng, 2009; Champion, 2008; Cunningham, 2010; Ott and Pozzi, 2011; Pujol and Champion, 2012).

5.5 Accuracy and realism
In cultural heritage, authenticity is of significant importance. In virtual heritage, however, it is impossible to incorporate true authenticity, in the sense that virtual heritage only portrays recreations or representations of the actual cultural heritage material. This is why in virtual heritage the ascertaining of the element accuracy and realism is so important, as this even without its actuality can convey a sense of authenticity.

5.5.1 Cultural and historical
The basis for all types of accuracy and realism in virtual heritage applications is that of the cultural and historical. All other elements dealing with accuracy and realism are ultimately tied to this one. If the environment, objects, buildings, characters or events in the virtual heritage application are not culturally and historically accurate representations of the setting they are supposed to depict, the application may lose its sense of authenticity.

Pujol and Champion (2012) refer to the cultural and historical aspects of virtual heritage applications as cultural presence. They write that “Cultural presence includes a learning component that is aimed at generating awareness or understanding about cultures. (...) [Cultural presence] is measured as a degree of accuracy in the reconstruction of the culture.” (Pujol and Champion, 2012, p.91). Thus, without cultural and historical accuracy a virtual heritage application cannot in its players generate a true understanding about the culture represented, which is one of the goals of virtual heritage. They also write that “…we suggest virtual heritage should (...) aim to carefully capture objects and processes of scientific, social or spiritual value. Second, it should present this information as accurately, authentically, and engagingly as possible.” (Pujol and Champion, 2012, p.86). Many other authors agree with them regarding the element of cultural and historical accuracy and realism (Bellotti et al, 2012; Blake and Ladeira, 2011; Champion, 2008; Champion et al, 2012; Chen et al, 2010; Cruz-Neira, 2003; Guttentag, 2010; Jacobsen and Holden, 2007).

5.5.2 Visual and behavioral
One of the most sought after elements for incorporation in virtual heritage applications is that of the visual and behavioral accuracy and realism. This became clear already during the initial search for literature for the development of this matrix, when a vast amount of technological studies were found which focused on this element alone (e.g. Blais and Beraldin, 2006; El-Hakim et al, 2004; Guidi et al, 2006; Sansoni and Docchio, 2005; Styliadis and Sechidis, 2011). The fact that these studies were not included in the review, however, does not affect the ultimate result. The majority of the articles selected for final review also displayed positive attitudes toward incorporating visual and behavioral accuracy and realism in virtual heritage applications (Anderson et al, 2010; Bellotti et al, 2012; Blake and Ladeira, 2011; Ch'ng, 2009; Champion et al, 2012; Chen et al, 2010; Chen et al, 2013; Cruz-Neira, 2003; Gabellone, 2009; Guttentag, 2010; Pujol and Champion, 2012; Stone et al, 2009; Wang et al, 2009). For instance, Bellotti et al. writes that “...the photorealism of 3D
models (...) is necessary to provide a highly impressive, culturally correct, and meaningful experience...” (2012, p.17:5).

Visual and behavioral accuracy and realism in virtual heritage applications can be upgraded by improving or implementing various features. The visual features involve for instance 3D models, textures and shaders. The behavioral involves for instance animation, artificial intelligence, crowd simulation and physics. According to Ch’ng (2009, p.465):

“In VH [Virtual Heritage], a living entity must in the least have “life”, appear to be living, or possess the simplest intelligence that enables it to make uncomplicated decisions. In this case, virtual birds that flock together and “flee” from threats can be considered “living”, so is a real-time virtual character that accomplishes certain tasks in his/her task environment.”

5.5.3 Environmental
Circumstantial and environmental accuracy and realism involves features such as weather, day and night cycle, wildlife and vegetation. As Stone et al. writes; “Unfortunately, many of the Virtual Heritage demonstrations to date have been very sterile—lacking the dynamic natural features evident in the real-world, such as environmental effects and the life cycles of flora and fauna.” (2009, p.13). Fortunately, it is becoming more important to implement these types of features (Blake and Ladeira, 2011; Ch’ng, 2009; Champion et al, 2012; Chen et al, 2010; Chen et al, 2013; Cruz-Neira, 2003; Gabellone, 2009; Hirayu et al, 2000; Pujol and Champion, 2012; Stone et al, 2009).

5.5.4 Auditory
“Although the visual aspects of VR often attract the most attention, an audio element also can be very important for the creation of realistic VE:s.” (Guttentag, 2010, p.639). Audio in virtual heritage applications could be applied to any instances which would normally give off sound, such as character dialogue, wind, footsteps, and much more. A track with music could also be implemented to help set the mood of the environment or an event. A few authors agree that auditory realism would be beneficial to incorporate into virtual heritage applications (Ch’ng, 2009; Blake and Ladeira, 2011; Guttentag, 2010).

5.5.5 Olfactory
Olfaction or olfactory perception is the sense of smell. The element of olfactory accuracy and realism is perhaps one of the most unusual elements to be incorporated into virtual heritage applications. But although it is uncommon, it is possible for a person to sense smells by using specific types of olfaction hardware to project chemically recreated odors into their immediate environment. According to Ch’ng “The sense of smell (olfactory) can improve presence via odor cues that can trigger reaction in the user.” (2009, p.463). Guttentag (2010) agrees with this point of view.

5.6 Summary of element matrix
Each element found to be indicated as sought after for incorporation in virtual heritage applications has been thoroughly analyzed and described. To also provide a version of the element matrix which can be used to gain a quick overview, it is summarized in a table (Table 2), which gives a short description of each element and presents references to those articles which indicated the element in question was sought after.
<table>
<thead>
<tr>
<th>Elements</th>
<th>Short description</th>
<th>Articles</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Interactivity</strong></td>
<td>Ability to affect, use or communicate.</td>
<td>Anderson et al, 2010</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Bellotti et al, 2012</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Ch’ng, 2009</td>
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<tr>
<td></td>
<td></td>
<td>Champion, 2008</td>
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<td></td>
<td></td>
<td>Champion et al, 2012</td>
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<td></td>
<td></td>
<td>Chen et al, 2010</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Chen et al, 2013</td>
</tr>
<tr>
<td>Exploration</td>
<td>Openly navigable environment.</td>
<td>Bellotti et al, 2012</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Champion et al, 2012</td>
</tr>
<tr>
<td><strong>Tasks</strong></td>
<td>Assignments, errands, missions, quests, challenges.</td>
<td>Anderson et al, 2010</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Bellotti et al, 2012</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Ch’ng, 2009</td>
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<tr>
<td></td>
<td></td>
<td>Champion, 2008</td>
</tr>
<tr>
<td>Dialogue</td>
<td>Communication/Conversation between player and non-player character.</td>
<td>Blake &amp; Ladeira, 2011</td>
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<td></td>
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<td>Champion et al, 2012</td>
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<td></td>
<td></td>
<td>Cruz-Neira, 2003</td>
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<td></td>
<td></td>
<td>Jacobsen &amp; Holden, 2007</td>
</tr>
<tr>
<td>Quiz</td>
<td>Test with questions.</td>
<td>Bellotti et al, 2012</td>
</tr>
<tr>
<td><strong>(Meaning)</strong></td>
<td>Elements specifically adding deeper meaning.</td>
<td></td>
</tr>
<tr>
<td>Culture and history</td>
<td>Intangible heritage. Cultural expressions, rituals, traditions, customs, skills, beliefs, values. Historical events and developments.</td>
<td>Anderson et al, 2010</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Bellotti et al, 2012</td>
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<tr>
<td></td>
<td></td>
<td>Blake &amp; Ladeira, 2011</td>
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<tr>
<td></td>
<td></td>
<td>Champion, 2008</td>
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<td></td>
<td></td>
<td>Champion et al, 2012</td>
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<tr>
<td></td>
<td></td>
<td>Chen et al, 2010</td>
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<tr>
<td></td>
<td></td>
<td>Chen et al, 2013</td>
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<tr>
<td>Story</td>
<td>Plot/Narrative.</td>
<td>Ch’ng, 2009</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Chen et al, 2013</td>
</tr>
<tr>
<td><strong>(Player character)</strong></td>
<td></td>
<td></td>
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<tr>
<td>Roleplay</td>
<td>The player assuming the role of the player character.</td>
<td>Ch’ng, 2009</td>
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<tr>
<td></td>
<td></td>
<td>Cruz-Neira, 2003</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Jacobsen &amp; Holden, 2007</td>
</tr>
<tr>
<td>Avatar</td>
<td>Visual representation of the player character.</td>
<td>Blake &amp; Ladeira, 2011</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Bellotti et al, 2012</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Ch’ng, 2009</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Champion, 2008</td>
</tr>
<tr>
<td>Personalized avatar</td>
<td>Possibility to alter the appearance of the player character.</td>
<td>Chen et al, 2013</td>
</tr>
</tbody>
</table>
| **Other characters** | Real or virtual characters/actors. | Anderson et al, 2010  
Blake & Ladeira, 2011  
Bellotti et al, 2012  
Ch’ng, 2009  
Champion et al, 2012 | Chen et al, 2010  
Chen et al, 2013  
Cruz-Neira, 2003  
Jacobsen & Holden, 2007  
Pujol & Champion, 2012 |
|---------------------|----------------------------------|--------------------------------------------------|--------------------------------------------------|
| **Multiplayer**     | Ability to play with other players in the same environment. | Ch’ng, 2009  
Champion, 2008  
Ott & Pozzi, 2011  
Pujol & Champion, 2012 |
Blake & Ladeira, 2011  
Champion, 2008  
Champion et al, 2012  
Chen et al, 2010 | Cruz-Neira, 2003  
Guttentag, 2010  
Jacobsen & Holden, 2007  
Pujol & Champion, 2012 |
| **Cultural & historical** | Cultural and historical correctness. | Anderson et al, 2010  
Bellotti et al, 2012  
Blake & Ladeira, 2011  
Ch’ng, 2009  
Champion et al, 2012  
Chen et al, 2010  
Chen et al, 2013 | Cruz-Neira, 2003  
Gabellone, 2009  
Guttentag, 2010  
Pujol & Champion, 2012  
Stone et al, 2009  
Wang et al, 2009 |
Ch’ng, 2009  
Champion et al, 2012  
Chen et al, 2010  
Chen et al, 2013 | Cruz-Neira, 2003  
Gabellone, 2009  
Hirayu et al, 2000  
Pujol & Champion, 2012  
Stone et al, 2009  
Wang et al, 2009 |
| **Environmental**   | Weather, day and night cycle, wildlife, vegetation. | Blake & Ladeira, 2011  
Ch’ng, 2009  
Champion et al, 2012  
Chen et al, 2010  
Chen et al, 2013 | Cruz-Neira, 2003  
Gabellone, 2009  
Hirayu et al, 2000  
Pujol & Champion, 2012  
Stone et al, 2009  
Wang et al, 2009 |
| **Auditory**        | Sound. | Ch’ng, 2009  
Blake & Ladeira, 2011 | Guttentag, 2010 |
| **Olfactory**       | Smell. | Ch’ng, 2009 | Guttentag, 2010 |
6 Game element review

6.1 Can what we want be found in games?

With the completed element matrix in mind, a number of modern entertainment video games, containing examples of the established elements, are selected for review. Based on the author’s own previous experiences as a video game player and developer, combined with the use of appropriate search words extracted from the element matrix, the search for games is conducted informally using Google. Whether a game is selected is based on the depth and degree to which elements from the element matrix are incorporated within it. Also taken into account is the game’s popularity, both peer and critical acclaim.

The age appropriateness of video games, which is for instance based on their inclusion of profanity, discrimination, and violence, is not taken into account when selecting video games for review in this study. The reason for this is that this study does not mean to suggest that the reviewed games should be used as virtual heritage applications themselves. It is merely suggested that the specific elements reviewed and the described key features of these elements can be used as inspiration for adults who develop virtual heritage applications. The matters described in this study’s game reviews has, based on the ESRB Ratings Guide (Entertainment Software Rating Board, n.d.), not influenced the games’ ratings in a way which makes the games inappropriate for children. Thus the game reviews can be used as inspiration even for virtual heritage applications which include younger target audiences.

The search conducted lead to the selection of four games of the genres 3D role-playing game and 3D action adventure game respectively. The selected games were found to incorporate many of the elements from the matrix (Table 3), and they have received wide peer and critical acclaim according to Gamespot and IGN.

**Table 3** Elements incorporated in the video games selected for review

<table>
<thead>
<tr>
<th>(Meaning)</th>
<th>The Elder Scrolls V: Skyrim</th>
<th>Mass Effect</th>
<th>Assassin’s Creed II</th>
<th>Red Dead Redemption</th>
</tr>
</thead>
<tbody>
<tr>
<td>Interactivity</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>Exploration</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>Tasks</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>Dialogue</td>
<td>X</td>
<td>X</td>
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<tr>
<td>Quiz</td>
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<tr>
<td>(Player character)</td>
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<tr>
<td>Roleplay</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>Avatar</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>Personalized avatar</td>
<td>X</td>
<td>X</td>
<td>-</td>
<td>-</td>
</tr>
</tbody>
</table>

Meaning of symbols:  X = Incorporated. / = Not fully incorporated. - = Not incorporated.
Other characters | X | X | X | X
Multiplayer      | - | - | - | X

(Accuracy & realism)

Cultural and historical | - | - | / | /
Visual and behavioral    | X | X | X | X
Environmental           | X | / | / | X
Auditory                | X | X | X | X
Olfactory               | - | - | - | -

### 6.1.1 Selected video games

“What modern entertainment video games are relevant to investigate for the development of virtual heritage applications?”

The game *The Elder Scrolls V: Skyrim* (Bethesda Game Studios, 2011) is an action role-playing game released in 2011. From here on this game will be referred to simply as *Skyrim*. *Skyrim* won many awards the same year of its release, for instance both GameSpot’s (2011) and IGN’s (2011) awards for Best Role-Playing Game. The game features a vast, open, lush, and living world, in which the player is given much freedom of choice and possibility for adventure. Worth mentioning is also that *Skyrim* offers its players modification privileges through the use of its so called Creation Kit. Using the Creation Kit it is possible to edit or replace most elements incorporated in the game. *Skyrim* incorporates more elements from the element matrix (Appendix A) than any other game which was considered for this review. Because of this it is arguably the most fitting example of how the elements sought after for incorporation in virtual heritage applications can occur in combination with one another in modern entertainment video games. To make proper use of this, a descriptive overview of all of the elements occurring in *Skyrim* is provided.

Instead of reviewing the three additional games in their entirety, a few specifically prominent elements which occur within them have been selected to be examined more closely. The first of these three games is *Mass Effect* (Bioware and Demiurge Studios, 2008). *Mass Effect* was released to PC in 2008, as the first installment in the action role-playing game trilogy bearing the same name. It contains “…an epic story bolstered by engaging characters and rich, branching dialogue.” (Watters, 2008), and hence makes a suitable example of the elements other characters and dialogue. The second game selected is the action adventure game *Assassin’s Creed II* (Ubisoft Montreal, 2009). *Assassin’s Creed II* takes place in late 15th century Italy, and features many historical locations, as well as several historical figures. It makes a suitable example of the elements cultural and historical accuracy and realism, as well as visual and behavioral accuracy and realism. The last game selected is called *Red Dead Redemption* (Rockstar San Diego, 2010). *Red Dead Redemption* was released in 2010, and has since received great critical and peer acclaim. It won GameSpot’s (2010a) Best New Character award and IGN’s (2010a) Best Character award the same year of its release, notably both as the editors’ and readers’ choice. It also won the editors’ Best Story awards on both websites (GameSpot, 2010b; IGN, 2010b). *Red Dead Redemption* acts as a fitting example for the elements story and roleplay. Additionally, it serves as the example provided of the element multiplayer.
6.1.2 Unincorporated elements

The search for games to review elicited suitable examples of incorporation of all the elements from the established matrix, except two. These two elements are quiz, and olfactory accuracy and realism. Regarding olfaction, research on using this element, even for virtual reality purposes, is limited, and perhaps even more so for video games. This may be the reason why it is so rarely incorporated in virtual reality type applications (Guttentag, 2010). Until more research has been conducted, and thus more attempts at using the element have been made, it will be difficult to draw any valid conclusions as to what effect incorporation of the element of olfaction could have on virtual heritage applications.

Quizzes are commonly used in traditional board gaming, and have also successfully been featured as the single element of some video games, such as the Buzz! series of quiz video games (Relentless Software, 2005-2010). But quizzes are generally not incorporated alongside several other elements in modern entertainment video games. One reason for this may be that it can be difficult to make answering quizzes a natural and intrinsic part of the gameplay. If an element in a video game is unnatural and extrinsic, it may break the immersion of the player, leading her/him to losing interest.

6.2 What kind of examples do games have of what we want?

“In what ways can elements which are indicated as sought after for incorporation in virtual heritage applications occur in various modern entertainment video games?”

6.2.1 The Elder Scrolls V: Skyrim – Accuracy and realism

Skyrim (Bethesda Game Studios, 2011) is a 3D action role-playing game with an entirely fictional setting. The game is set in the northern province of Skyrim, on a planet called Nirn. Skyrim’s landscapes are vast, varied and dynamic. Traversing the land the player comes across snowy mountains, shaded valleys, peaceful villages, open fields, cultivated farm lands, dirty sewers, flowing rivers and waterfalls, volcanic tundra, dark and damp caves, fortified strongholds, abandoned campsites, lush deciduous and coniferous forests, bustling cities, and more (Figure 4).

Figure 4 Two examples of landscapes in The Elder Scrolls V: Skyrim (Bethesda Game Studios, 2011)

Skyrim is however not just varied in terms of landscape and flora, but fauna too. There are wild predators, such as bears, and wolves, which are hostile toward the player and will attack if s/he comes close. There is also wild prey, like for instance deer, rabbits, and foxes, which
shy away as the player approaches. In addition to wild animals, there are also those which have been domesticated, such as chickens, goats, and dogs. There are also horses which the player can ride. *Skyrim* incorporates a high degree of environmental realism. As time passes, day turns to night, and back again, although be it faster than in real life. The weather changes as well; it can be sunny and clear, foggy and rainy, windy and snowy, cloudy and overcast, and so on. Different landscapes are more prone to different types of weather as well.

The visual and behavioral realism of *Skyrim* is perhaps not always quite up to par with its environmental counterpart. “Closer inspection reveals hard edges, plain painted-on textures, and other visual flaws that are conspicuous should you seek them out. But like many enormous games, Skyrim makes a fantastic impression not because its individual elements are sharply honed, but because they contribute to a grander whole.” (VanOrd, 2011). One facet of *Skyrim* which makes a major contribution to this grander whole is the element other characters and their behavioral realism.

> “Citizens go about their daily lives, selling their wares in shops during the day and closing down at night to hang out in the pub or head home to rest. Under some circumstances, they may comment on your rancid breath or remark on how sickly you seem to look. Children run up and down the streets; one may even ask for you to stop a bully from picking on him.”

VanOrd, 2011

In addition to the already addressed types of realistic elements in *Skyrim* there is that of its sounds. It is easy to forget to take proper notice of *Skyrim’s* element of auditory realism, due to the fact that the sounds of *Skyrim* blend naturally into their different contexts. Fires crackle, rivers flow, birds chirp, rain drizzles or pours, wind blows, bears roar, people speak, and so on.

### 6.2.2 The Elder Scrolls V: Skyrim – Interactivity

The opportunities for interactivity in *Skyrim* are many. The game features an open world which the player can explore at will, and there is much to explore, and also to do, in *Skyrim*. For instance, the player can hunt wild animals, skin them, and tan the hides at a tanning rack to make leather. Leather, as well as other items which can be found, made, or bought, can in turn be used for crafting. Many items which the player can use in the game can be crafted using the appropriate crafting tools (Figure 5). To craft some items the player requires metal, which s/he can either buy or go mining for her/himself. But apart from tasks related to crafting, the player can also gather herbs and mushrooms, cook, shop for items, go riding, chop wood, buy a home, help farmers with farming, go treasure hunting, and do various types of quests to help the inhabitants of Skyrim. By incorporating an explorable world with many different tasks which the player can choose to do, the player gets to experience for her/himself what life is like in Skyrim – only to a certain degree of course, but the intention is something to be considered, nonetheless.
The player character is far from the only character in *Skyrim*. Even after playing the game for hours and hours on end, it is doubtful that the player will have met, let alone talked to all of Skyrim’s inhabitants. The player is at times addressed by other characters as s/he walks by. But if the player at any time wishes to engage in mutual dialogue with other characters, s/he can do so easily by approaching them and simply clicking the button assigned to interaction in *Skyrim*. Once the dialogue has been initiated a number of options, or phrases, which the player can choose to talk about are opened up. The options can vary a great deal depending on the character the player is interacting with. Each chosen option grants a different response from the other character. Some options lead to new options opening up, while some others end the dialogue. This type of dialogue system which *Skyrim* incorporates is not out of the ordinary for video games, but the amount and variation of information possible for the player to gain from it is. Topics which the player can choose to talk about can be for instance personal questions, local gossip, or more generally the culture of Skyrim. Many dialogues are also connected to various quests which the player can choose to partake in. In spite of *Skyrim*’s fictional setting, its dialogues are an example of how dialogue in digital applications can provide much information for the player about the history, culture, and climate of the time and place the application portrays.

### 6.2.3 The Elder Scrolls V: Skyrim – Player character, other characters, and meaning

In *Skyrim* there are several ways for the player to personalize her/his character and avatar, allowing the player to create a character which s/he can identify with. Early on in the game, the player is prompted to begin personalizing her/his character via *Skyrim*’s character creation screen (Figure 6). The player can choose a character of various races, such as orcs, or wood elves. Different races also begin with different abilities. As the game progresses and the player uses her/his character’s abilities, s/he will gain points which s/he can use to upgrade any abilities of her/his choosing. This is one way in which the player may keep on personalizing her/his character throughout the game. After choosing a race for the player character through the character creation screen, the player gets to personalize the appearance of her/his avatar further. The player can change the sex of the character, skin tone, eye color, weight, hairstyle, as well as alter various facial features, and more. Later on in the game s/he also gains the possibility of changing her/his character’s clothing and

![Figure 5 A blacksmith’s station in *The Elder Scrolls V: Skyrim*](bethesda_game_studios_2011)
jewelry. The player character can wear many different kinds of apparel, ranging from blacksmith’s aprons to noble’s robes, and from light leather to heavy ebony armor.

![Character creation screen in The Elder Scrolls V: Skyrim](image)

**Figure 6** Character creation screen in *The Elder Scrolls V: Skyrim* (Bethesda Game Studios, 2011)

As previously mentioned, *Skyrim* contains a large number of characters other than the player character. Some characters can join the player on her/his journey throughout Skyrim, and some can even become love interests which the player can choose to have her/his character marry. No matter how small or big their connection is to the player character, however, they all contribute to the bigger picture that is the culture of Skyrim. The residents of Skyrim are aware of and take a stand in ongoing events, both major, such as the civil war which plagues Skyrim, and minor, such as the player accidently knocking over a vase. Some characters stereotype based on race, while others make no such distinction. Some do only what is profitable for themselves, while others dedicate their lives to the benefit of others.

*Skyrim*’s main storyline revolves around mighty dragons, which have been prophesied to destroy all life and consume the world upon their return. The prophecy speaks of a so called ‘dragonborn’, a person chosen by the gods to defeat the dragon threat. The player eventually learns that the role of the dragonborn is that of her/his character. Another part of the prophecy tells of the ongoing civil war between the so called Imperials and Stormcloaks. The player can choose to help the Imperials secure their holding of Skyrim, or help the Stormcloaks rebel and take back the land they consider to be theirs. “You can choose one side or the other, but so much of the allure of Skyrim is how, even outside of the confines of quest lines, the embattled state of the world is evident, and steeped in a rich fictional legacy.” (Onyett, 2011). Separate from the main storyline the player can choose to try her/his luck with the questionable Thieves Guild, hone her/his battle skills with the Companions, or perfect her/his magical abilities at the College of Winterhold. If none of these seem inviting, the player might instead choose to go on a religious pilgrimage to worship the gods, or aedra as they are called in *Skyrim*, by following the path of the Nine Divines. Or perhaps s/he might prefer to lead a simpler life by helping the locals with their personal problems, although that may not always be as simple as it first may seem.

There is such an abundance of things to do, places to go, and people to talk to in Skyrim, that altogether it seems to be “...a world that existed long before you showed up and will continue to exist long after you leave” (Onyett, 2011). Perhaps using the elements identified in *Skyrim*, virtual heritage applications could achieve that same result.
6.2.4 Mass Effect – Other characters, and dialogue

Mass Effect (Bioware and Demiurge Studios, 2008) is a 3D action role-playing game set in a fictional future of the late 22nd century. Humankind has developed the ability to travel vast distances through space quickly, using a phenomenon called the mass effect. They have encountered and developed relationships with various extraterrestrial species, as well as established several new human colonies across the Milky Way galaxy. The player takes on the role of Commander Shepard, a human veteran soldier, who commands a team of soldiers, both humans and aliens, on a space ship called the Normandy. The team travels to many different planets and colonies across the galaxy in order to find and take down a rogue former Spectre (a type of special forces agent) called Saren Arterius, as well as various other threats along the way.

As Commander Shepard travels across the Milky Way galaxy, several characters join her/his team. Apart from Shepard, the team ultimately consists of six characters; two humans and four aliens (Figure 7). All of the characters have different backgrounds, personalities, opinions, behaviors, and skills. Talking with these characters in the game helps Shepard to connect to and build relationships with them. The better Shepard gets to know them, the more they feel comfortable talking about themselves and the world around them, as well as their personal opinions and feelings about different events that take place as the game progresses. Some of the characters can even become romantic interests for Shepard. As Brudvig (2007) writes; “These humans and aliens aren't just there to help you in a fight. They're there to help you make sense of the galaxy”.

Take, for instance, the character Ashley Williams. By talking to Ashley throughout the game, the player can learn about what makes her the person she is. For instance, the player can learn that she is a tough and blunt soldier. That she hails from a family of military soldiers, and she herself enlisted in the Navy as soon as she graduated from high school. She grew up in various human colonies where she helped to raise her three younger sisters with their mother, while their military father was deployed to different combat zones. She has strong religious beliefs, though she is hesitant to talk about any specifics regarding her faith due to fear of how the other members of Shepard’s crew might react. These are just a few examples of the many things a player can learn about Ashley, and just a tiny fraction of the information the player can learn about people and their lives in Mass Effect.

Figure 7 Mass Effect team members (Bioware and Demiurge Studios, 2008)
**Figure 8** Example of dialogue in *Mass Effect* (Bioware and Demiurge Studios, 2008)

*Mass Effect* is an example of how the user of a digital application can be helped to gain an understanding for its content through the use of the dialogue element. The way dialogues work in *Mass Effect* is somewhat uncommon for videogames. All characters are voice acted, lip synced and animated realistically. The camera cutting and angles makes it look like an interactive movie. “Your only job is to pick from a series of gut feelings. It's all done quickly and pain free with a dialogue wheel that pops up on the bottom of the screen. Once you've made your decision, Commander Shepard turns your feeling into complete thoughts.” (Brudvig, 2007) (Figure 8). In each dialogue there are different alternatives for the player to choose from, each alternative will prompt a different response from the other character. But the larger picture is affected too, for instance there are times when choosing one alternative over another may lead to serious consequences later on in the game.

### 6.2.5 Assassin's Creed II – Cultural, historical, visual and behavioral accuracy and realism

*Assassin's Creed II* (Ubisoft Montreal, 2009) is a 3D action adventure game set in an adaptation of late 15th century Italy, during the Renaissance. The player takes on the role of a young Italian named Ezio Auditore da Firenze. Ezio can perform a wide range of actions and movements, such as walking, swimming and riding. Much of the exploration in *Assassin's Creed II* is however made by navigating walls and rooftops, as Ezio can climb and jump between practically any surfaces that look like they can be grabbed on to or landed on. All of this possibility for movement and exploration is paired with a high degree of behavioral accuracy and realism. As VanOrd (2009) writes, Ezio “...is one of the best-animated characters yet seen in a game. [...] When Ezio climbs, his hands are grabbing something and his feet are resting on something”. But it is not just Ezio that comes across as realistic, but also the other characters in the game.

“Citizens go about their daily lives, and they look authentic doing so. Merchants sweep the street in front of their shops; small groups stroll along, making conversation with each other; and courtesans smirk and cajole as you pass by. These folks aren’t cookie-cutter character models. They are dressed differently enough from each other and are animated so expressively that it’s as if the population would go about its business with or without your presence.”

VanOrd, 2009
There is a great deal of strangers in *Assassin’s Creed II*, but there are also several famous historical characters, such as Niccolò Machiavelli, the Pazzi family, Pope Alexander VI, and Leonardo Da Vinci. However, all of *Assassin’s Creed II*’s characters are historically inspired, i.e. not necessarily historically accurate. However, the degree of historical accuracy in the game is somewhat improved by *Assassin’s Creed II*’s incorporation of a Database. The game’s Database consists of entries with information about some of the characters Ezio meets throughout the game, as well as certain locations s/he visits (Figure 9). Although the Database entries in *Assassin’s Creed II* are mostly informal and of varying historical accuracy, the idea of incorporating a database containing additional information about the contents of the application is something to be considered. A Database like *Assassin’s Creed II*’s could be a positive addition to some virtual heritage applications if the entries were historically accurate.

![Database entry on the Santa Maria Novella, in *Assassin’s Creed II*](Image)

In *Assassin’s Creed II* the player gets to visit several virtual recreations of locations and buildings that exist in the real world. The player can for instance visit the Santa Maria Novella in Florence, or the Basilica di San Marco in Venice (Figure 10). According to Patrice Désilets (Gamespot, 2009), creative director for *Assassin’s Creed II*, historians worked with the development team on a weekly basis, helping them with all aspects of accuracy and realism in the game. The development team also spent several days in Italy, taking over 30,000 photographs as references for the locations in the game. Désilets (Gamespot, 2009), however, also explicitly expressed that even though much research went into the accuracy and realism of the game, the fact is that *Assassin’s Creed II* is a game, and that fact entails certain constraints. In video game development, it is generally considered that a lower degree of accuracy is acceptable if the entertainment level of the gameplay is kept, i.e. the gameplay must not suffer to ensure accuracy. Thus, the recreated locations and buildings in *Assassin’s Creed II* are of varying historical and visual accuracy. But even so, for a video game, its historical and visual accuracy is high. I argue that the overall look and feel of the historical locations is still there, even though there for instance at some places are some windows missing, and some buildings are smaller in the game than in real life.

![Figure 9 Database entry on the Santa Maria Novella, in *Assassin’s Creed II*](Image)

(Ubisoft Montreal, 2009)
6.2.6 Red Dead Redemption – Story, roleplay, and multiplayer

*Red Dead Redemption* (Rockstar San Diego, 2010) is a 3D action adventure game set in a fictional representation of the American/Mexican frontier at the turn of the 20th century. It depicts a time “...when the lawless and chaotic badlands began to give way to the expanding reach of government and the spread of the Industrial Age” (Rockstar San Diego, 2010). The game begins with an introductory sequence depicting the protagonist and player character John Marston (Figure 11) being escorted by two gentlemen to a train. The train is taking him from the northern industrialized city of Blackwater, to the more modest frontier town of Armadillo. As Marston is riding the train he overhears some of the other passengers’ conversation. For instance, a couple of older ladies, who appear to be of rather high class, discuss how America is “...finally bringing civilization to this savage land”. This is an example of how the game is set to depict a “period of great change between this savage, horrendous world with delusions of nobility evolving into modern society”, as Dan Houser, vice president and co-founder of Rockstar Games, expresses it (Robinson, 2010). Brudvig (2010a) writes that “Rockstar shows an uncanny ability to hold a mirror up to society and remind us that present day hot button issues like racism, immigration, federal government power and personal freedoms are not only nothing new, they are deeply ingrained in American society”. The way of *Red Dead Redemption* is not a history lecture, but the history is there, nonetheless, for the player who is interested and who pays attention.

Brudvig (2010a) continues; “...rather than preaching politics at you, *Red Dead Redemption* puts you in the shoes of the relatively neutral John Marston”. As the story progresses the player finds out that Marston is a former outlaw who is now struggling as he pays the prize for his difficult past. He has been taken away from his wife and son by the Bureau of
Investigation, who has promised to grant him amnesty if he brings the remaining members of his old gang to justice. The story takes the player through anything and everything from performing odd jobs at a small time ranch to taking part in various shootouts. Along the way, the player gets to meet, among others, the characters Bonnie MacFarlane, a local rancher who is struggling to make a decent living; Nigel West Dickens, a con artist who sells patent medicines; the U.S. Marshal Leigh Johnson and his deputies; as well as Abraham Reyes and Luisa, a Mexican rebel leader and his lover. By meeting them, the player is given the possibility to gain insight into their situations. By learning about their different circumstances, opinions, ideals, and backgrounds, the player may gain an understanding for what it may have been like for different types of people to live in parts of early 20th century America and Mexico.

The character which the player is given most opportunity to learn about is logically the character s/he is playing. *Red Dead Redemption* lets the player take on the role of John Marston to great extent however the player sees fit. The player can make Marston return to his old ways as an outlaw; leaving helpless women to die in the desert, raiding the countryside, and breaking the law in any other way s/he sees possible (Brudvig, 2010b). This has repercussions however, for instance the player the player gets a bounty placed on Marston’s head, which dangerous bounty hunters can attempt to collect, and other characters shy away from Marston in terror. But although living life like that may have been a reality for some in the early 20th century, allowing such reckless behavior may not be appropriate in virtual heritage applications, but the degree of freedom which is granted the player is nonetheless something to be considered. Playing the bad guy is not the only choice given in *Red Dead Redemption*, though. The player can instead choose the role of a hero; chase off poachers, save women in peril, give away money to the needy, or just explore and take in the beautiful scenery (Miller, 2010).

Whether playing *Red Dead Redemption* as a hero, an outlaw, or something in between, if the player wishes to take part in the main storyline of the game s/he will need to fire some bullets. Violence in video games is a delicate topic, especially if it is provided no explanation or justification. But in *Red Dead Redemption*, it is made clear that Marston is uncomfortable with the violent actions that the Bureau of Investigation is both directly and indirectly forcing him to take. Although he has been an outlaw in the past, he does not want to be one anymore. Marston just wants to be with his family – which is shown mainly through his dialogue with different characters throughout the story. Toward the end Marston leads an assault on the hideout of the leader of his old gang, called Dutch van der Linde. Marston and Dutch shout back and forth to one another:

Dutch: “Working for the government, John? After all I taught you?”
Marston: “I don’t have a choice! [...] They’ve got my family!”
[...]
Dutch: “You can’t erase the past, John, you can’t make it go away!”
Marston: “That’s where you’re wrong!”

Excerpt from dialogue in *Red Dead Redemption*, 2010

The story of *Red Dead Redemption* may at times seem somewhat cliché, especially for someone who has watched many old famous western movies. But whether *Red Dead Redemption* is historically plausible or not, it is an example of how digital applications can have its users play the role of a historical character, either famous or not. The elements of
story and roleplay, like *Red Dead Redemption*’s, can put the player in the shoes of someone entirely different, let the player live part of his life, and see the world from his point of view.

Playing through the entire storyline of *Red Dead Redemption* can take approximately 20 hours (Brudvig, 2010a), but there is much gameplay aside from that as well. In addition to the single-player world, there are a number of different multiplayer options available for *Red Dead Redemption*’s players. The one which I argue is of most interest to the virtual heritage field, however, is called Free Roam. Free Roam is essentially *Red Dead Redemption* without a storyline for up to 16 players at the same time (Brudvig, 2010a). The players can team up with friends or complete strangers, and play as heroes, or outlaws, or any shade of grey in between. They can explore the world of *Red Dead Redemption*, search for treasure, hunt animals, go bounty hunting, save the innocent, tame wild horses, take on bad guys together, and much more.
7 Conclusions

7.1 Summary of findings

“In what ways can elements which are indicated as sought after for incorporation in virtual heritage applications, according to recent virtual heritage research, occur in various modern entertainment video games?”

To answer this posed problem statement, a systematic literature review was conducted first, using 18 journal articles by the virtual heritage field. It resulted in the identification of 17 elements, which could be regarded as sought after for incorporation in virtual heritage applications, which were sorted into a matrix. An informal search for modern entertainment video games containing the identified elements was then carried out. The search resulted in the recognition of elements to a large degree in four popular video games adhering to the video game genres of 3D role-playing games and 3D action adventure games. Only two elements, olfactory accuracy and realism, as well as the quiz element, were unable to be identified in modern entertainment video games. The remaining fifteen were in the first instance analyzed and described as they occurred in The Elder Scrolls V: Skyrim (Bethesda Game Studios, 2011). Three more games, Mass Effect (Bioware and Demiurge studios, 2008), Assassin’s Creed II (Ubisoft Montreal, 2009), and Red Dead Redemption (Rockstar San Diego, 2010), were chosen to provide additional insight and example of a few select elements. Ultimately, the descriptive element matrix and the reviews of games incorporating the elements provide a point of reference which could be of use in the future development of the virtual heritage field and its applications.

7.2 Discussion

7.2.1 Problem statement, method and findings

The chosen method to find out what elements are indicated as sought after for incorporation in virtual heritage applications was that of conducting a systematic literature review of recent virtual heritage research. However, this matter could have been investigated in other ways. For instance, people working in the virtual heritage field, or virtual heritage related areas, such as museums, could have been questioned through interviews or a survey. But finding subjects who could contribute with opinions, thoughts and ideas as representative of the virtual heritage field at large as a literature review can be would have been difficult, if not impossible. When conducting research on people or using people, there is also always an elevated human factor and possibility of tainting the results – a risk which is kept at a minimum by conducting a literature review. The method of conducting game reviews to investigate in what ways elements which are indicated as sought after for incorporation in virtual heritage applications can occur in modern entertainment video games could also have been made in the same way as described. Although, in this instance, the people chosen for the investigation would have been video game developers or researchers, the problems entailed would still have been similar.

17 elements sought after for incorporation in virtual heritage applications were identified as a result of this study. However, sometimes one cannot want something until its existence is known, or until it is known how that existence may take form. The results of this study show that the reviewed video games incorporate most elements found to be sought after by the virtual heritage field, in ways which to a large degree seem to be unexplored by the virtual
heritage field, possibly because they were unknown to them. The element matrix and game reviews resulted from this study may for this reason be enlightening sources of inspiration for the virtual heritage field. The element matrix, or at least parts of it, could also be used as a list of elements which ought to be considered for incorporation in most virtual heritage applications. Parts of the video game community which takes interest in developing historical or cultural heritage games could also benefit from the findings of this study, in a similar way to that of the virtual heritage field. More generally speaking, I also argue that all fields may benefit from investigating elements used in other fields for inspiration, one possible way of doing so being using the same or a similar method to the one used in this study.

The possibility for someone else to reproduce this study has been kept as great as possible by describing the methods used for each part of the study as thoroughly and explicitly as possible. Thus, assuming that all parts would remain the same if the study would be reproduced, the one part which is still somewhat open to differences is the selection of modern entertainment video games for review. Although the search was conducted using terms from the established element matrix, as well as variations of these which are commonly used in the field of modern entertainment video games, the search was informal, and the use of different search words could lead to a somewhat different result. But the fact that the games selected in this study have received very high peer and critical acclaim points to that they would have a great possibility of being selected again if the study was reproduced. However, even if we assume that the video games selected possibly would not have been the exact same games, it is likely that the games would have been similar. Video games of the same genre generally incorporate the same types of elements in similar ways. Thus it is likely that the search would have resulted in video games of the same genres which the search in this study resulted in, i.e. 3D role-playing games and 3D action adventure games, and that the elements within the games would have functioned in similar ways. However, even if we pretend that that would not have been the case, any examples found would still have been valid examples, all contributing to providing new inspiration for the virtual heritage field.

The video games which were selected for review in this study had all been previously played by the author. In no way were the selection of the video games based on the authors own experiences of playing these video games, however. As mentioned previously, the selection was only based on the results of the informal search, as well as the video games peer and critical acclaim according to the leading video game news and reviews sites Gamespot and IGN. Although the selected video games are games which not only have received peer and critical acclaim, but which the author has enjoyed as well, the descriptions and reviews of the video games and the elements within them have been kept as objective and neutral as possible, devoid of any personal opinions or feelings of the author.

### 7.2.2 Future of virtual heritage

Many virtual heritage applications are developed for public establishments, such as museums, at which varying amounts of visitors are elders. Older generations may experience difficulty to adapt to forms of interactivity to which they are not accustomed. In modern society, practically all types of media are becoming increasingly interactive; virtual heritage applications, as well. Particular consideration may need to be taken to older generations in order to not neglect and alienate this part of the virtual heritage audience.
In the past the virtual heritage field has focused on the recreation of visuals, and the accuracy and realism of these visuals. But this accuracy may become less important as other elements, such as characters, culture and history, gain greater interest. I argue that the future incorporation of additional elements can make the visual accuracy less important, as the degree of overall accuracy is enhanced. But to what degree visual accuracy and realism can be altered or sacrificed, and to what degree it is acceptable that the overall perceived historical accuracy is affected by it, depends on the purpose of the virtual heritage application in question. For instance, choosing a different graphical style than realistic could be considered if the virtual heritage application was made to depict the life of a painter. If the purpose of the application is to have its users learn about how this particular painter visually interpreted the world around her/him, it could be interesting to use the same visual style for the application as s/he used in her/his paintings.

If the visual accuracy could become less important as other elements are increasingly incorporated in virtual heritage applications, it is possible that the historical accuracy might also become an element which is open for discussion. Humanity’s knowledge of our own history is often flawed; there are gaps in time about which nothing is known, as well as records of events in time which seem contradictory or even impossible. For virtual heritage applications incorporating elements of culture and history, problems like these need to be sorted out and any possible gaps must be filled in. These problematic parts in time could logically not be depicted completely historically accurate, but the goal would instead become historical plausibility. Further difficulty surfaces when considering who would determine what is historically plausible and what is not. It is possible that what one person finds plausible, another might consider unlikely.

Another problem which the virtual heritage field must face is that of funding. In this study, *The Elder Scrolls V: Skyrim* (Bethesda Game Studios, 2011) is used as a primary example of how the majority of elements sought after for incorporation in virtual heritage applications can occur in modern entertainment video games. The total cost of developing and marketing *Skyrim* was approximately 85 million US Dollars (Statistic Brain, 2012). Even if this were only somewhat indicative of how much funding is needed to be able to incorporate as many elements of a similar standard as *Skyrim* in other applications, it bears the question whether this is a possibility for virtual heritage applications. Generally speaking, the field of modern entertainment video games has access to great possibilities for funding. But what they lack is the virtual heritage field’s will to make applications which are as culturally and historically accurate as is humanly possible. This is arguably the most fundamental purpose of the virtual heritage field. In conclusion; in the past it has been claimed that “where there is a will, there is a way”, but for the virtual heritage field it is possible that it ought instead to be phrased “where there is will, but not enough money, there is no way”.

### 7.2.3 Ethics and morality

Humanity’s past is, among more positive matters, riddled with injustice, discrimination, violence, and death. As of yet, this may not be a problem for the virtual heritage field. But as elements of culture and history seem to be increasingly sought after for incorporation in virtual heritage applications, it will become all the more important for the virtual heritage field to separate their goal of cultural and historical accuracy, from what may come across as discrimination and violence propaganda. These types of matters are widely discussed and contested regarding the field of video games. As the virtual heritage field draws nearer to the
field of video games they must ensure their preparation for similar criticism should they begin to depict some of the more difficult parts of human history.

7.3 Future work

In this study what elements are indicated as sought after for incorporation in virtual heritage applications was studied by reviewing recent virtual heritage research. In the future, one could attempt to investigate what elements are sought after specifically by the public. On way of doing so would be to use the element matrix established in this study as a basis for gathering the public’s opinions. Another could be to start anew, allowing elements not found in this study to be identified, and form a new matrix. Then the element matrix derived from this study and the element matrix derived from the public could be cross-referenced in order to identify similarities and deviations between the two.

The reviews of the selected modern entertainment video games’ elements in this study are only a few examples of how the elements identified as sought after for incorporation in virtual heritage applications could be incorporated in a virtual heritage application. Providing examples of every way in which an element can be incorporated would be virtually, if not literally, impossible. But even though not all ways could be analyzed, future research could be conducted to find more ways than those described in this study. This could provide a greater and possibly a more varied selection of examples, and thus more material for the virtual heritage field to be inspired by.

In this study elements indicated as sought after by the virtual heritage field were identified first. Only thereafter were elements’ appearances in modern entertainment video games investigated. It is possible that there are elements in video games which could be suitable for incorporation in virtual heritage applications which the virtual heritage field, and by extension also I, have overlooked. Further research could be conducted by starting with identifying what types of elements can be found in video games, in order to then be able to further investigate their suitability for incorporation in virtual heritage applications. In such a case, one could also investigate whether there are elements in video games which are particularly unsuitable for incorporation in virtual heritage applications.

In regards to future work, the resulted element matrix and game reviews of this study could be used a basis for inspiration when making a virtual heritage application, or a cultural heritage video game. A prototype application for non-commercial use could be made using the video game *The Elder Scrolls V: Skyrim*, previously described in this study. In its original form *Skyrim* already has support for most of the elements from the established element matrix, and using its correlated Creation Kit, most of the game’s elements can also be modified or replaced.
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