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The Virtual Memory Palace

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Abstract

The intention of the Virtual Memory Palace is to help people memorize information by addressing their visual memory. The concept is based on the "Memory Palace" as an ancient Greek memorization technique, where symbols are placed in a certain way within an imaginative building in order to remember the original information whenever the mind goes through the vision of this building again. The goal of this work was to create such a Memory Palace in a virtual environment, so it requires less creative effort of the contemporary learner than was necessary in ancient Greece. The Virtual Memory Palace offers the possibility to freely explore a virtual 3d architectural model and to place icons at various locations within this model. Specific behaviors were assigned to these locations to make them more memorable. To test the benefit of this concept, an experiment with 15 subjects was conducted. The results show a higher remembrance rate of items learned in the Virtual Memory Palace compared to a wordlist. The observations made during the test showed that most of the subjects enjoyed the memorization environment and were astonished how well the Virtual Memory Palace worked for them.

Keywords: Virtual Memory Palace; virtual environment

1. Introduction

The idea for this work arose from the Memory Palaces used in the book 'Hannibal' by Thomas Harris [1]. The technique used by the protagonist to memorize information implements a potential for today's increasing demands to master the information oversupply.

1.1 The Memory Palace

The concept is based on an ancient Greek memorization technique, the "Memory Palace". It is said to have its origin at about 500 B.C. At that time, there were not as many possibilities to write down stories and scientific knowledge as today. As a consequence mental techniques were developed to store and memorize information, based on the assumption that orderly arrangement is essential for good memory [2]. One of these techniques (originally described in the treatise *Ad Herennium* of an unknown Greek author [2]) starts with the imagination of a large building (i.e. a "palace"). While mentally walking though the buildings, symbols of items to remember are placed in various locations. In addition, every symbol is associated with a particular (ideally surprising or at least unconventional) behaviour or event. It enhances the remembrance rate by focusing attention. Since human memory, as well as human perception, is primarily focused on visual aspects, the repeated imagination of this building and a virtual walk through it supports the remembrance of all the items placed in it. As these are easier to remember than just a list of words or data, this technique helps to remember the information associated with the respective symbol. In addition, storing a particular path through the "Memory Palace" reduces the risk of leaving out an important piece of information along an argumentative concept (or a story).

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1.2 A Virtual Memorization Environment

Today's information society tends to rely on technological memorization support like filofax, PDA, or other electronic storage devices rather than sophisticated memorization techniques. Although many of the old practices have been lost to most of us, there is still an undisputed need for good personal memory. However, creating, maintaining and exploring a large and complex building in mind are not so very common today. Therefore, good creative potential is required for this technique. It occupies the other activities or might even have to be regained by regular practice. Parts of it can, however, be replaced – or at least supported in the initial phase – by the technology of Virtual Environments. Immersive Virtual Environments like Head Mounted Display (HMD), CAVE™ [3], Immersion Square [4], or even an interactive 3D scenario on a PC screen. This allows the exploration of virtual rooms and buildings while feeling as an integral part of the scene, without stressing imagination too much. In addition, there is one significant problem with the purely mental Memory Palace. It is being present only in its creator's mind, all the knowledge stored in a Memory Palace is lost when this mind expires. Permanent storage and transfer of a mental Memory Palace are difficult, if not impossible.
It was therefore the intention of this work to develop a Virtual Environment that mimics the concept of the Memory Palace, while it supports imagination as well as storage and transfer of the content.

2. Implementation

A prototype of a *Virtual Memory Palace* (VMP) has been implemented by creating an explorable 3D model of a palace-like building composed of 4 sections (see Figure 1).

2.1 Setup

In the interior each of the sections hosts one or more rooms, each containing one or several activateable objects like a table, a picture on the wall, and curtain where symbolic icons can be placed choosing an arbitrary image file (in a standard format like jpg, gif, etc.) from the file system.

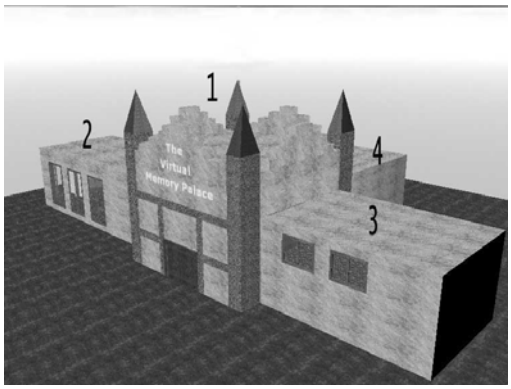

Figure 1 : The Virtual Memory Palace (VMP)

These active objects (which, as in the Greek original Memory Palaces, shall be called "loci") are indicated by a "smiley" image and once an image file is associated to the related locus a particular behavior or event is triggered (like, e.g. the painting crashing down from the wall, see Figure 2) drawing the user's attention on the information symbol when approaching.

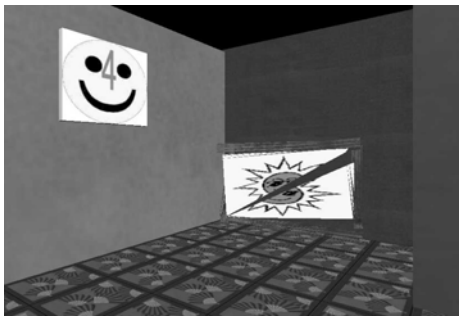

Figure 2: Active icon in the VMP (room #4)

Navigation and interaction has been implemented with the VR authoring Software Virtools Dev. So the VMP can be used in an immersive virtual environment like the Immersion Square [4] as well as on a usual PC via the Internet or on a stand-alone system. Aiming at optimal efficiency, a Memory Palace should be designed according to certain rules as adopted from the ancient original.

2.2 Rules for Optimizing Memorization

First it is helpful if the Memory Palace is uncrowded, or better yet an empty place because crowded places tend to weaken the impressions [2]. Another principle is that the loci should have a distance of about 10 meters between each other in the imaginative building. Every fifth locus should have a unique sign (like, for example, a glowing exclamation mark) grouping the loci in one's mind, thereby generating a substructure that helps to locate oneself within the memory path. One should avoid repetitive environments for the reason that the mind remembers non-uniform setups better than monotonous ones. Therefore, ten pillars in a row would be a bad setup example for loci. The two remaining rules are that one should not create one locus in a too spacious room or place, nor in a too narrow one. Finally the loci should not be too darkly or too brightly lit for shadows tend to cover the memorization of the images placed in the locus and too bright illumination of the locus weakens the image because it makes it shine and dazzle.

The rules can be summarized as:

- Solitary space, not crowded.
- Distance of about 10 meters between loci.
- Unique sign every fifth locus.
- No repetitive environments.
- Loci in a not too spacious or too narrow place.
- Loci not lighted too dark or too bright.

The rules for images representing the data to remember are not so common compared to the rules for places and require a little more creativity. In order to make the images more memorable, the unknown author of the *Ad Herennium* suggests making them look unusual, for unusual or ridiculous things are remembered better because they are different from one seen in everyday life [2]. Examples would be to imagine an object wrapped in a purple cloak, a picture soiled with mud or anything one can imagine to make the object look unusual. In general this means the loci are supposed to be different from one would expect them to be. Here creativity and imagination of the user are required. After the images are placed on the loci the users are able to wander through their Memory Palace and demand from the loci the images they contain.

2.3 VMP Prototype

A VMP prototype was implemented as a palace-like building with 4 sections (see Figure 1), with several rooms distributed over 2 floors. These rooms offer 10 loci where information can be placed (see Figure 3).

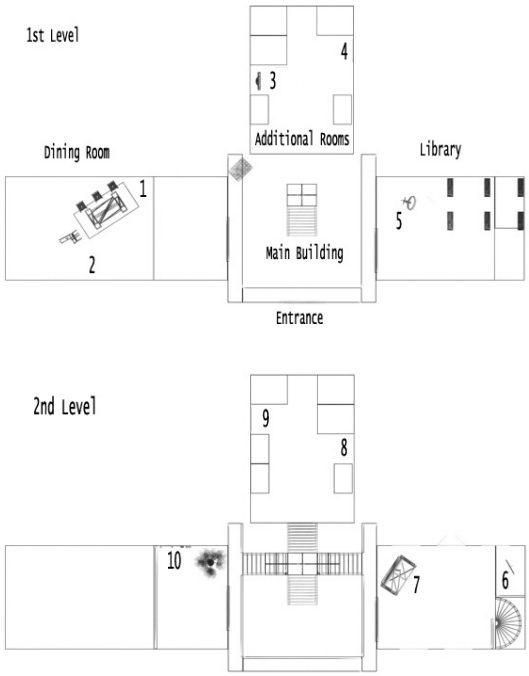

Figure 3: VMP ground plan

According to the rules mentioned in section 2.2, the place is not crowded with other characters but the users are alone in the environment. The loci were also positioned neither too close nor too far away from each other.
A short sound (e.g. breaking glass, metal hit, wind) was associated to every object so that the visual information is accompanied by an audio signal. This sound is played once after assigning a picture to it (or when it is activated by approach).

3. Evaluation

In order to evaluate the benefit of the Virtual Memory Palace as a means to support memorization, a basic test was conducted.
This evaluation is an initial scoping study, based on a similar test described [6]. It compares the remembrance rates of the VMP with a simple list of words with the same number of items on it. The results of these tests provide the basis for observations. This can help develop future design guidelines specifically for Virtual Memory Palaces.
The tests were conducted on a contemporary PC-system with a common monitor and investigated the different remembrance rates of the abstract and the visual memory. The subjects had to memorize either a list of ten simple words (like “guitar”, “anchor”, etc.) or were given the task to memorize visual representatives of similar words which could be placed as icons in the VMP. Some of the icons even did not exactly represent the word to memorize but rather gave a hint to the related meaning (e.g. a pig-shaped savings box representing the expression “money bank”). In order to achieve a representative result, the tests were taken by 15 subjects - male and female from different age groups (21 – 51). The previous experiences with virtual environments varied from “none at all” over “have a general idea” to “very familiar”. The previous experiences had no obvious effect on the results in the different parts of the test. Every subject took all parts of the tests.

3.1 Test Setup and Realization

The tests consisted of three parts in order to test the short-term and the long-term memory of the abstract and visual memory. The short-term memory of both the abstract and visual memory was tested directly after the learning process. The long-term memory of both methods was tested one week after the test.

The following setup was used for the tests:

Part 1:

1. The subjects were handed a list of ten words. They had 3-5 seconds for each word in order to memorize them. This was the time that was estimated for the exchanging of the textures in Part 2. It was used as a guideline for the subjects. The maximum time was 5 seconds.
2. After all ten words had been learned the subjects were asked to do basic mathematical calculations (+, -, *, /) for 2 minutes.
3. After finishing the calculations the subjects were questioned to repeat as many words as they were able to remember.

Part 2:

4. The first part was followed by an explanation of the idea of the Memory Palace with an introduction to the virtual environment. The loci are numbered from 1 to 10 to give the subjects a guideline where to go and which objects are activateable loci. The subjects were given 5 minutes to find the path from locus 1 to locus 10 and to familiarize with the environment and the movement of the avatar.
5. When the subjects felt comfortable with the environment they were advised to assign pictures to the several loci by clicking on the objects and choosing a texture from a list of pictures. At the same time the subjects were asked to try to make an association with either the object, the sound that comes with every exchange or with both. The subjects were requested not to take more time with the pictures than with the words on the wordlist from part 1.
6. After assigning a picture to each locus and trying to make an association, the subjects were again given calculations for 2 minutes.
7. The subjects were asked to repeat as many pictures (representing words) as possible.

Part 3:

8. After one week the subjects were interviewed again for the words and pictures they remembered from part 1 and part 2.

3.2 Test Results

Figures 4 and 5 show the results of the interviews directly after the calculations and one week later, respectively.

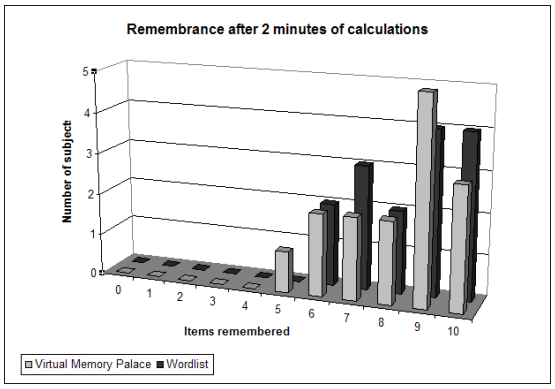

Figure 4: Items remembered after 2 min of calculations

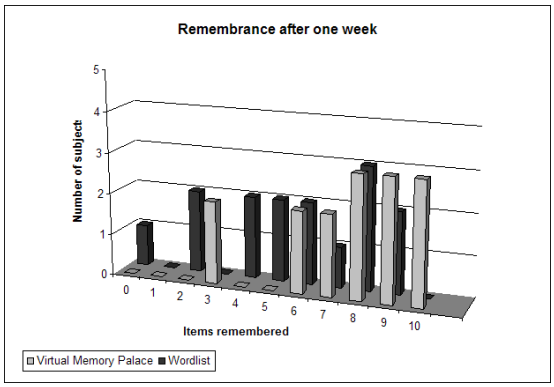

Figure 5: Items remembered after one week

The average remembrance rate of items per subject of the wordlist and the Virtual Memory Palace can be calculated by using equation (1), where:

R_i = Number of items remembered
s = Number of subjects
x = Average amount of remembered items per subject

$$x = \frac{\sum_{i=0}^{10} R_i}{s} \qquad \textbf{(1)}$$

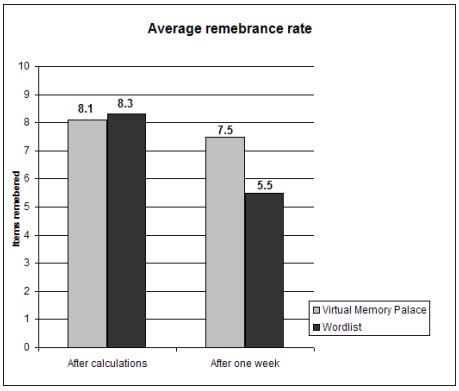

Figure 6: Average remembrance rates

After two minutes of calculations x is 8.3 for the wordlist vs. 8.1 for the VMP. It is not a significant difference – and if so it would count in favour of the wordlist technique. After one week, however, the remembrance rate for the wordlist dropped to 5.5, while x for the VMP went down only to 7.5, which is a plus of more than 25% compared to the wordlist (see Figure 6).

3.3 Conclusion

Although these tests are no more than an initial scoping study and should serve as a guideline for future refined tests, the results strongly indicate a benefit from the VMP for long term memory. In addition, some more subjective observations should also be kept in mind for the design of future tests.

3.4 Further Observations

Most subjects found the idea very interesting and expressly said that they enjoyed the Memory Palace concept. Some were astonished about their working. When asked to remember the items from the Virtual Memory Palace one even said “Oh, that is easy now” and remembered all 10 items without hesitation. Others felt overwhelmed with the task of moving around in a virtual environment and remembering items at the same time. One interesting case was one subject who could not remember one single item from the wordlist after one week yet achieved a result of 6 items with the Virtual Memory Palace. One week earlier, directly after the calculations he remembered 9 items from both parts of the test. A lot of the subjects could be observed, "walking" through the Virtual Memory Palace in their minds. Gestures and mimic expressions gave clues where they found themselves in the virtual environment. Pointing at different positions on the table, describing the environment and intensely thinking about the positions of the loci and the pictures on them with closed eyes gave further insights on how the subjects were remembering the items.

4. Outlook

Currently working on a project called “VirSchool – The Future of Cooperative Learning”. It originates from the Virtual Memory Palace. The goal of this project is to bring people into a technology enhanced, virtual, 3-dimensional learning environment in the style of 3D Adventure-Game/Massively Multiplayer Online Game where the users will *experience* a topic rather than learning it by heart.

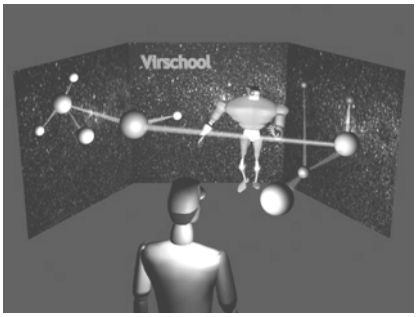

Figure 7: The VirSchool

The course will be set up in a CAVE™ like environment (see Figure 7). In this projection room the learners will be positioned in the middle of a virtual environment which is screened onto the canvases on the three sides of the room.
The learners are then free to start their learning experience and they will be given tasks and puzzles to solve in order to proceed through the topic and learn about the subject. This setup will serve as a framework for a series of tests. It consists of 20 different pieces of information about important key points of a chosen “game” topic.
This standalone course is then extrapolated to a network of cooperative learning environments that will take the learning experience to an even higher level. Figure 8 shows the network of the VirSchool concept where several knowledge providers offer their courses to each other and the users. The users enter the virtual course-network at an entry point (as shown in Figure 7). They are then able to choose from a variety of topics that are available.

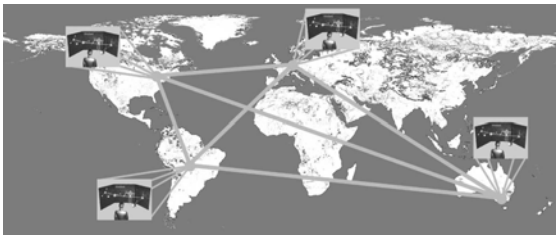

Figure 8: A Worldwide Network of Cooperative Learning Environments

The VirSchool offers unique opportunities to get people involved in the lifelong learning process by addressing the natural instinct of curiosity to learn by playing games. It transfers the features that lead to the success of games and makes use of this knowledge to create a vibrant and creative, cooperatively learning and working research community.

Acknowledgements

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