NeverMind: Using Augmented Reality for Memorization

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ABSTRACT
NeverMind is an interface and application designed to support human memory. We combine the memory palace memorization method with augmented reality technology to create a tool to help anyone memorize more effectively. Preliminary experiments show that content memorized with NeverMind remains longer in memory compared to general memorization techniques. With this project, we hope to make the memory palace method accessible to novices and demonstrate one way augmented reality can support learning.

Author Keywords
Memory augmentation; memory palace; method of loci; augmented reality; educational interfaces.

ACM Classification Keywords
H.5.m

INTRODUCTION
The memory palace or method of loci is an ancient Greek method that can be used to memorize (almost) anything. It is used for tasks such as remembering exam material, languages, presentations, speeches and more. Many memory athletes, including USA memory champion Joshua Foer, claim to use this method [1].

The memory palace method works as follows. Given a concept or word you want to memorize, you come up with a visual mental symbol for this concept that will help you remember it by association. Then, take this imaginary image and mentally place it in an architectural scene. Finally, to recall your concept, you imagine the scene you mentally created and the concept you want to remember will effortlessly emerge.

Typically, the memory palace method is used to memorize a series of items. In such cases the method involves imagining a route in the mental architectural space and placing mental symbols along that route. When recalling the sequence, you need to revisit that route mentally to recall the concepts.

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However, getting started with the memory palace method can be a difficult and demanding cognitive task. The method involves imagining a space vividly in your mind, which can be challenging for novices. To address this problem, we propose to use reality as the memory palace. We believe that using routes and locations that the user has physically experienced and is familiar with eases the use of the method. We use augmented reality technology to offload the mental effort involved in imagining and associating symbols and use real scenes instead.

At first, it might seem a counterintuitive strategy since you need to remember both a place and the actual content you want to memorize, but, in fact, the opposite is true. Current neurological research has proven spatial navigation and memory both engage the same part of the brain, the hippocampus. Brain scans of "superior memorizers", 90% of whom use the memory palace method, have shown that it involves activation of regions of the brain involved in spatial awareness, such as the medial parietal cortex, retrosplenial cortex, and the right posterior hippocampus [2]. The memory palace method takes advantage of this fact to facilitate encoding, storing and retrieval of information.

NEVERMIND INTERFACE
NeverMind is an Augmented Reality system that enables a user to use the spaces they are familiar with to build their own memory palace and memorize lists of items.

Figure 1. The NeverMind app (left) handles user interaction, the headset (middle) displays the information, the user sees the content at their current location (right).

The interface is divided into two parts: an iPhone app that handles user interaction and an Epson Moverio BT-200 augmented reality headset for displaying graphical content. A program that runs in the Unity3D video game engine is

responsible for receiving the images from the iPhone app and displaying them on the augmented reality glasses.

The NeverMind app has two modes, setup and train. The setup mode lets the user define a route and populate the locations with the graphical content that will help them memorize. When setting up the routes, users select images from Google image search or their phone's camera that will help them retrieve the concept they intend to remember. In train mode, the user sees the images on the AR headset when they reach the location they are associated with.

EXPERIMENTS

We have run a preliminary experiment to test the NeverMind interface with 14 subjects. Participants were all college student volunteers from different educational backgrounds. Before starting the experimental task, 64% of the participants stated in a survey they had average or below average memory.

Each participant performed two memorization tasks, of 10 items each, one using a printed list of items and another one using NeverMind. We tested our subjects on two similar lists of items. For the list of 10 Super Bowl champions from 1967 to 1976 for the NeverMind-based task and the champions from 1977 to 1986 for the paper-based task. We verified that the subjects had no previous knowledge of the content they were tested on before running the experiment.

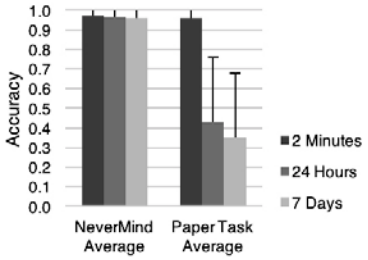

Figure 2. Recall accuracy for the experiment task using NeverMind compared to the paper based task.

For the paper-based task, subjects were handed a printed list of 10 items and were told to memorize the content. For the NeverMind-based task, we used a 200-meter route all participants were familiar with. For verification purposes, we showed a map with the specific route we would take during the memorization task. Next, we preloaded the interface´s images for the users. For example, we used a picture of a man on a horse to represent the Dallas Cowboys, a picture of an airplane to represent the Houston Jets and so on. Next, the subjects walked through the route, visualizing in AR the content NeverMind displays at each location. Then we tested their ability to recall the content memorized in the tasks in three different time spans, after 2 minutes, after 24 hours and after 7 days.

Results show that recall rate 2 minutes after each task has similar values (NeverMind: Avg.=0.97, SD=0.06; Paper: Avg.=0.96; SD=0.07). However, significant improvements in recall were observed after 24-hours (NeverMind: Avg.=0.96, SD=0.07; Paper: Avg.=0.43; SD=0.33), suggesting that that the content studied with the NeverMind interface is remembered for longer than with a traditional study method. 7 days after the task the content recall rate with NeverMind hold similar values to the 24-hour task (NeverMind: Avg.=0.96, SD=0.09; Paper: Avg.=0.35; SD=0.26). When questioned about the two methods, users claimed that studying with the NeverMind interface was much more enjoyable (71%) or more enjoyable (29%) and effortless compared to the paper-based study method.

USAGE SCENARIOS

Our motivation is to change the way students memorize. Students spend a lot of time memorizing based on repetition. This paper shows that there are more effective study methods that are in line with the way our brain stores information. We see potential uses in education, as a method to bootstrap knowledge as a starting point before making associations and inferences that are characteristic of higher levels of understanding. The system could be used, for example, for medical school students to facilitate learning the branches of the trigeminal nerve.

RELATED WORK

Previous work dedicated to recreating a virtual memory palace to enhance human memory involve either a computer simulation model or virtual reality [3][4]. Because NeverMind uses reality, the generation of a 3D memory palace is not necessary. Also, users can train on any route they are familiar with.

CONCLUSIONS

We have proposed a study model to help users master memory based on pairing spatial navigation and memory. We have designed NeverMind, a learning interface prototype to make memorization enjoyable and effective. With this project, we have provided an interface to make the memory palace method accessible to the general user.

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