Abstract

Attention Deficit Hyperactivity Disorder (ADHD) is a developmental disorder characterized by inattentive, hyperactive, and impulsive behavior. Children with this problem have difficulties at school and home. However, if the supporters around them do not know the cause is forgetfulness, their mistrust and frustration can quickly arise. Therefore, resolving their forgetfulness problem has a higher priority than other problems.

Because forgetfulness is a problem that can occur even in ordinary people, there are many countermeasures to deal with it. For example, some people write information they need to remember on a sticky note and post it where they can see it. However, people with ADHD often forget where they put the note, making it difficult to take countermeasures. Therefore, they need a system to remind information regardless of time.

The purpose of this study is to propose a new reminder system using mixed reality (MR) that smoothly solves the problem that people with ADHD are more likely to forget things than ordinary people.

We first surveyed previous studies on cognitive psychological models of human memory to achieve this goal. In the significant memory models proposed, information acquired by the five senses is input into sensory memory and retained for a short time. Only selected information from sensory memory is input to short-term memory and retained for approximately 15 seconds. Rehearsal is a repetitive act that prevents the loss of information to maintain the information in short-term or long-term memory. We hypothesized that people with ADHD are more likely to fail in short-term memory rehearsal due to impulsivity and inattention than ordinal people.

According to this hypothesis, there are some ways to counteract forgetfulness, such as increasing short-term memory capacity or aiding in rehearsal. Therefore, this study proposes a system that displays task text and pictures on a wall using HoloLens2, an MR device with a spatial mapping function to recognize walls. MR is one of XR (Extended Reality), such as AR (Augmented Reality) and VR (Virtual Reality). We have developed the system on Windows 11 using Unity and MRTK, which provides a series of components and functions to shorten the development time of MR applications in Unity.

Because the application could not acquire the walls recognized by the spatial mapping function, we implemented a function to acquire the coordinates of the walls by distributing the objects. However, the spatial mapping function recognizes all surfaces in real space, so information other than walls is displayed. Therefore, we developed a WallSonar object with CornerCube objects at the four corners and implemented a function to recognize only flat surfaces with a certain area.

We conducted a comparison experiment on 13 graduate students over two days to show how effective the proposed MR system is in reminding people of their forgetfulness compared to existing systems. Reminekun, a system related to LINE, which can alert the user with LINE-specific notifications even when other applications are used, was used as the control group.

In order to reproduce ADHD forgetfulness, we gave subjects a combination of inhibition and recall tasks in advance. By concentrating on the inhibition task among the multiple tasks, they may fail the rehearsal for recall tasks. By comparing the effects on their recall, we discuss the usefulness of the proposed method. Based on these prerequisites, we decided "watching videos for about 30 minutes and writing a report" as the inhibitory task. The videos titled "Information Security through Video" were provided by the Information-technology Promotion Agency, Japan (IPSJ).

Six recall tasks were prepared, three on the first day and three on the second day. Because too many tasks associated with the inhibitory task may trigger recall, it is preferable to use tasks that are as unrelated as possible. Even in the case of unusual tasks, the specificity of the task may trigger recall. For these reasons, the recall tasks were set to be natural ones usually performed daily.

Subjects were given written information about the inhibition task and verbal instructions about the recall tasks. They were then asked to wear the MR device. We explained that this was not an experiment in memory loss, but rather an experiment in concentration using an eye tracker to investigate the relationship between eye movements and reports. Since the MR device may need to be adjusted to the subjects eyes, we investigate whether each subject could be alerted by a simple display. After the setup of the MR device was completed, the subjects were asked to watch the videos. After viewing the videos, we asked the subjects to write a report, tell them that the experiment was over, and collected the MR device. At that time, we observed whether they forgot the recall task or not. This process was repeated twice on two separate days.

A t-test was conducted with the null hypothesis that there was no difference in the mean number of tasks recalled on the first and second days of the experiment, and the t-value was -5.20. The t-value was -5.20, and the p-value was 0.0001. This indicates that the difference between the mother means is significant, and that the MR system is more useful than Confirm it in terms of reminding the user of his/her forgetfulness. Therefore, the proposed MR system could smoothly counteract forgetfulness.

The system proposed in this study displays text on the wall to alert the user. However, when this system is used daily, it displays letters anywhere on a flat surface with an area larger than a certain level. It blocks information on walls

and objects other than walls with information from the beginning. Therefore, a function to recognize plain walls is necessary. Furthermore, experiments have shown that the proposed MR system is more helpful in reminding. However, we still need to evaluate the part of the system that inputs the recall task, and we would like to conduct experiments including the input.