

Proposal for Distraction in Pediatric Nursing Using Two-Screen Projection Method to Support Children Receiving Medical Care and Their Families

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Abstract—Our proposed two-screen projection is a cost-effective solution that creates the feeling that children with medical complexity and their families experiencing long-term hospitalization or behavioral limitations are outside the hospital or facility and can easily share their experience with others.

Index Terms—Projection, distraction, pediatric nursing

I. INTRODUCTION

Children with medical complexity (CMC) and their families often experience stress due to the numerous restrictions and interventions that are a part of their daily lives. Distraction techniques [1] have been recognized in pediatric nursing as a way to alleviate stress in children receiving medical care, and the value of promoting ingenuity in nursing practice has been emphasized [2].

Our group has focused on immersion, which promotes positive factors such as empathy, extraversion, and willingness to participate [3], and we predicted that the immersive experience provided by two-way communication would be an effective distraction in pediatric nursing. Therefore, we experimentally tested the hypothesis that an immersive experience with two-screen projection using a simple and cost-effective projection method may have a stress-reducing distraction effect, and obtained evidence that it could be implemented in society as an ideal form of nursing support.

II. PROPOSED METHOD

To enhance immersion in a virtual reality (VR) experience, the projection arrangement proposed in this study requires a wall screen that takes into account the horizontal field of view and the vertical field of view and a floor screen in the lower area, which together provide strong visual stimulation, as shown in Figure 1. Since the human binocular field of vision widens downward [4], visual information from below is particularly important for maintaining an upright posture, and the feet should be included in the image presentation area to enhance the immersive experience.

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Two-screen projection entails the utilization of two projectors, one projecting onto the wall and the other onto the floor, as depicted in Figure 2, thereby enabling an immersive experience within the hospital room.

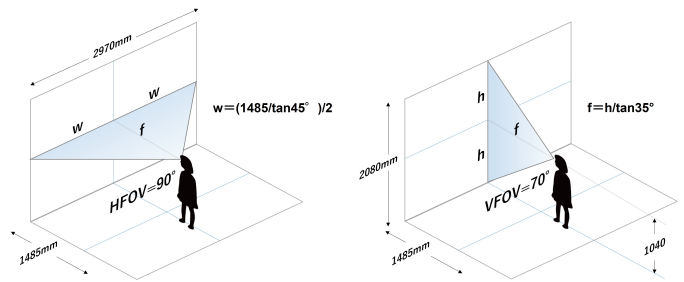


Fig. 1. Wall and floor screen settings according to viewing angle.

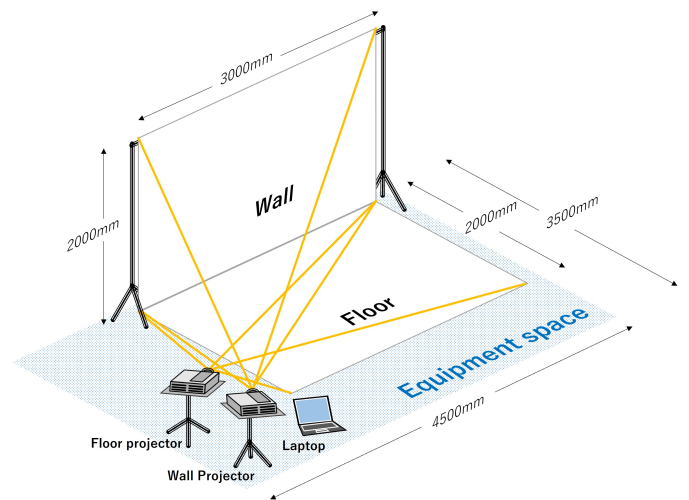


Fig. 2. Two-screen projection limited by equipment installation space.

The wall and floor projectors were placed within a projection space of 3000 mm by 2000 mm, positioned at an angle that minimized the reflection of a person's shadow being projected. The resulting two-screen projection system, shown

in Figure 3, provided an immersive VR experience within the limited space available.

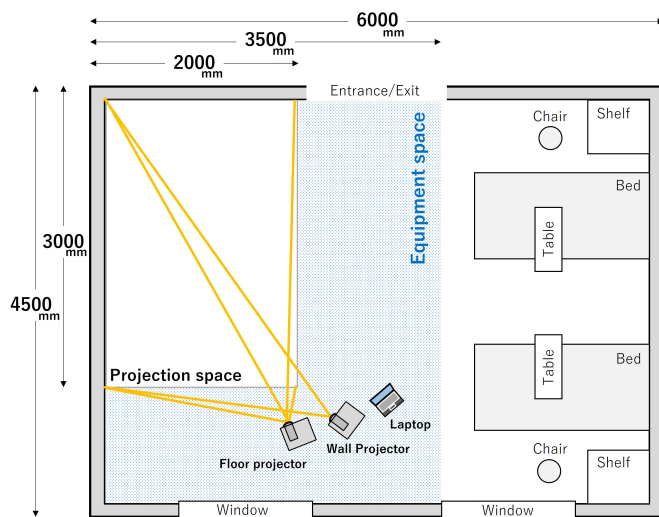


Fig. 3. Two-screen projection arrangement in a hospital room.

The necessary equipment and materials required for executing two-screen projection are commercially available, easily accessible, and appropriate for use in mobile settings. The process itself is uncomplicated, and it takes around 15 minutes from the preparation stage to the projection stage. The projection method used in this study presents a challenge in that the shape of the projected image does not align with the surface of the object being projected, owing to the projector's placement at an angle to the projection surface. To address this issue, an image transformation technique known as homography transformation was applied to the projected image.

Each experiment was conducted with the approval of the Ethical Review Board for Medical Research Involving Human Subjects of Gunma University (HS2021-112) (HS2022-095).

III. EXPERIMENTS AND RESULTS

A. Experiment 1

Subjects consisted of 30 healthy adult students and faculty members enrolled at University A who agreed to participate in the experiment between November 2021 and April 2022. Measurement of salivary α -amylase activity, a reliable non-invasive biomarker known to be increased by acute psychological stress, showed that the two-screen projection method significantly reduced subjects' stress levels compared to the one-screen projection method ($p < 0.05$).

B. Experiment 2

Subjects consisted of 24 people: 9 CMCs, 3 parents, and 12 staff members who used a multifunctional day care facility and agreed to participate in the experiment from December 2022 to April 2023. The experimental setting is illustrated in Figure 4. The KOKORO Scale, a mood measurement system that quantifies changes in human emotions and feelings, showed that the CMC's stress levels significantly decreased after the

two-screen projection compared to before the projection ($p < 0.05$).



Fig. 4. Two-screen projection arrangement in a hospital room.

IV. RELATED STUDIES AND DISCUSSIONS

There are two main types of interfaces for visually recreating immersive digital spaces. One is head-mounted displays, which are typically used as immersive displays, but they are inappropriate for use with CMCs because they are a physical burden and tend to inhibit interactive communication. There is another type of virtual environment called Cave Automatic Virtual Environment (CAVE) that uses the surrounding space as a display, but it requires a large space and multiple screens, projectors, and cameras, and is not suitable for mobile applications that can be set up in hospitals [5]. To overcome these issues, in this study we proposed a cost-effective solution for interactive communication: two-screen projection. This represents a crucial form of nursing support sought after by children receiving medical care and their families, and it holds significant potential for implementation as a creative approach to distraction in pediatric nursing.

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