

Serenity: A Low-Cost and Patient Guided Mobile Virtual Reality Intervention for Cancer Coping

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Background and Motivation

In a cancer diagnosis, the physical aspects of the disease is addressed but the mental health aspect is often overlooked.

During the course of a patient's treatment, they are vulnerable to depression, anxiety, and stress. This can lead to:

- > Treatment non-adherence
- > Negative impact on prognosis and mortality
- > Prolonged hospital stays and systemic burdens.¹

Approach

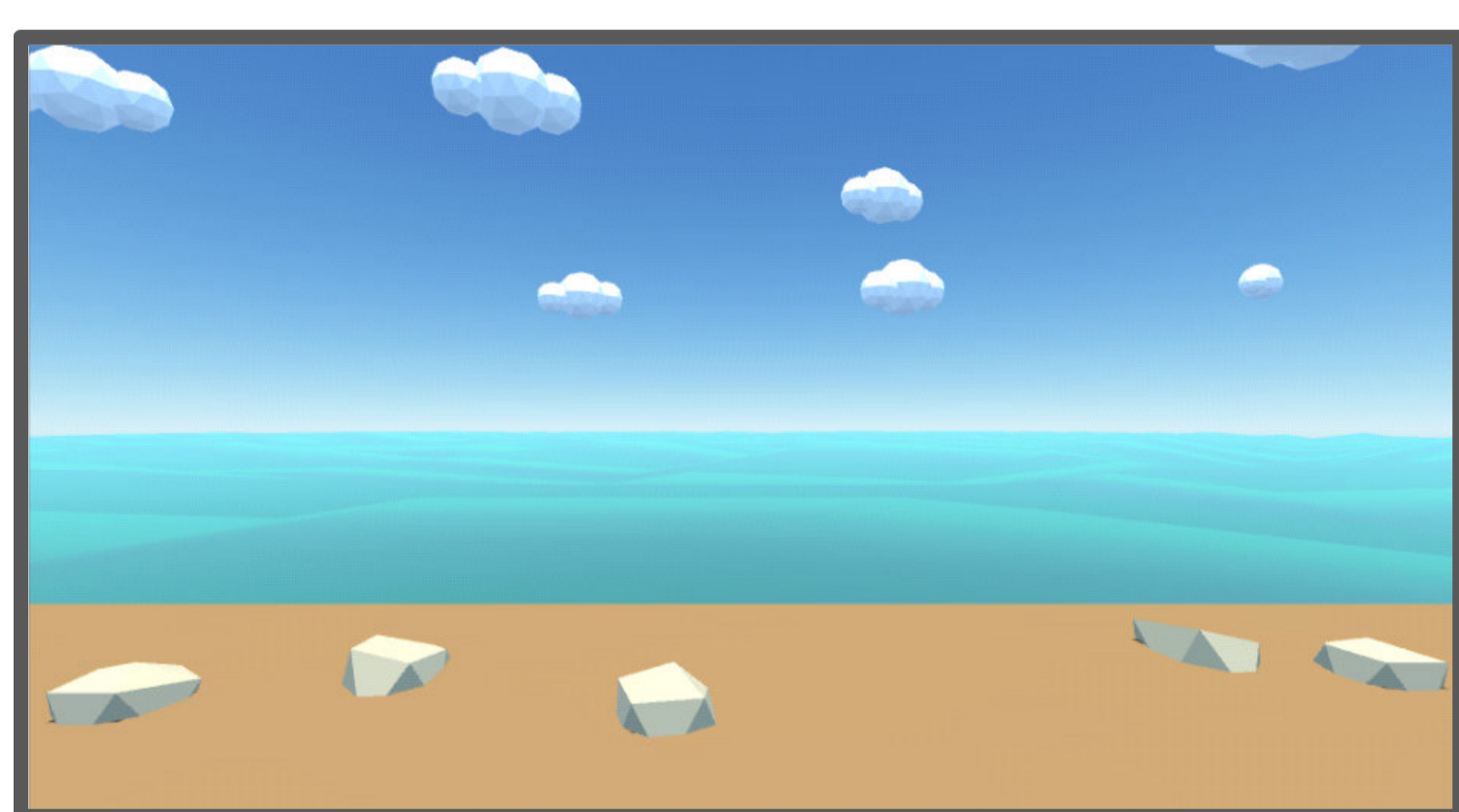
We use Google's Cardboard, a low-cost and widely adopted technology for virtual reality (VR), as a vehicle to empower patients to manage their behavioral health.

Our approach diverts the patient from his or her symptoms through improved psychological coping by simulating a virtual environment; immersing them in evidence based techniques, which include:

- > Mindfulness techniques
- > Kinesthetic interaction and learning
- > Relaxation breathing

Using psychological measures embedded in the platform, passive data about the patient is collected and combined with predictive analytics; this translates data into usable information for behavioral health provider(s) to personalize and enhance the intervention for patients.

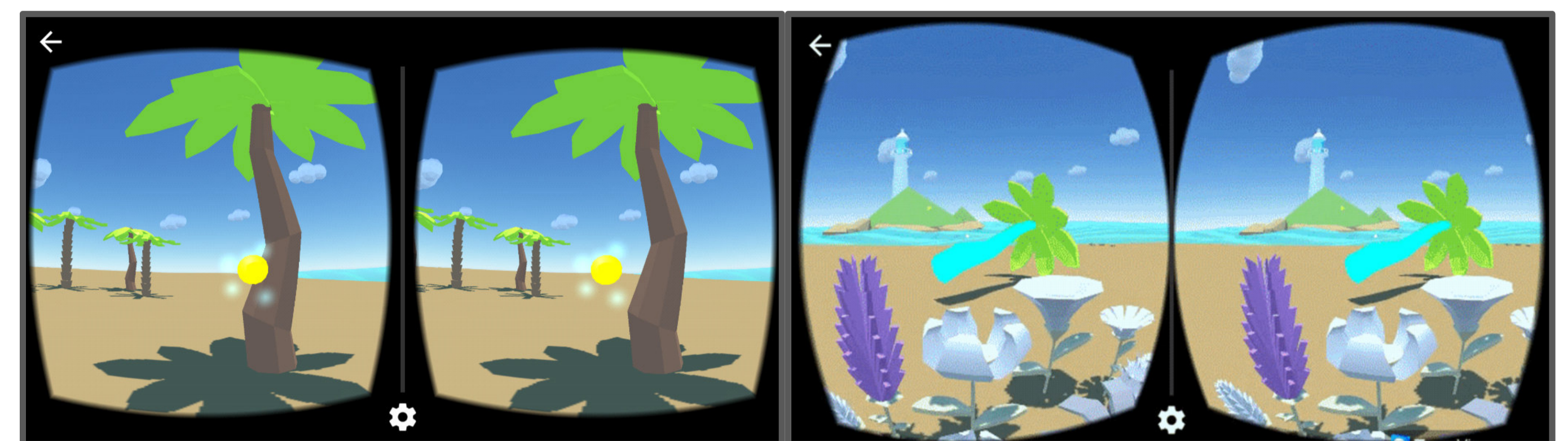
Accessible VR Platform



We developed a cancer coping mobile phone application running on the Android platform for Google Cardboard, allowing the intervention app to be deployed on off-the-shelf smartphones. The Cardboard VR viewer can be purchased for minimal cost (< \$20 USD) or easily built by end-user following freely available instructions.

Some Cardboard viewers as shown on right can be attached to a hat as an unobtrusive accessory and can be folded into a pocketable form factor. Left to the hat is a custom DIY fiducial marker controller.

Kinesthetic Interaction and Learning



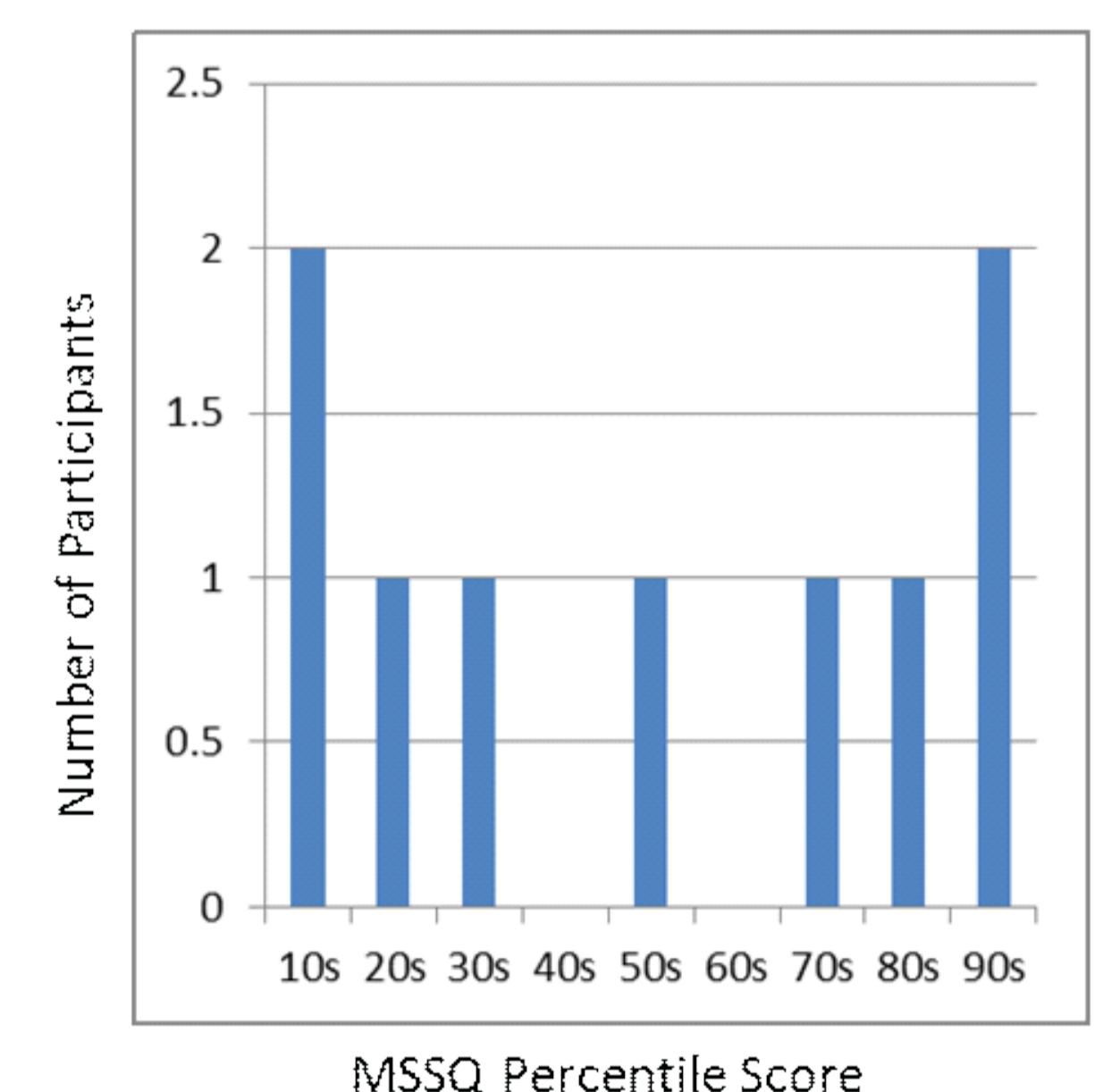
Informed by evidence of the therapeutic benefits of relaxation visualization, we simulate a virtual beach scene in VR with support for additional user tailored environments.² This allows the patient to experience the benefits of imagery without requiring high efforts in mental visualization.³

Enhancing interactivity can help sustain psychological immersion and engagement, augmenting therapeutic effects. The patient uses the fiducial controller to manipulate a three-dimensional cursor to interact with environmental objects such as comedically knocking over a tree.

Usability Testing

We first performed a heuristic evaluation with established VR guidelines for Cardboard, optimizing our app to the extent possible for frame rate and minimizedvection (illusion of self-motion) and acceleration.

We then conducted a two-stage usability test with 5 participants in each stage (3 men and 7 women). We used feedback from the first five testers to resolve system usability issues and resumed testing the revised version with the last five participants.



Results:

> HMD was not strenuous to wear but general comfort could be improved.

> Most participants had difficulty understanding hand controller interaction.

> Many participants described animated waves as calming or soothing.

> Some noted interaction using the hand controller and using the arrow interface induced some stress.

Others seemed to enjoy being immersed in the interactivity of coloring the flowers and knocking over the trees.

After the usability test, each participant completed the Motion Sickness Susceptibility Questionnaire (MSSQ).

We saw a U shaped range of responses. The high scores represent a high susceptibility to motion sickness and low scores indicate low susceptibility.

We were also concerned that anxiety might influence reports of nausea or dizziness, so we also recorded our subjective impression of each participant's level of anxiety (low, medium, high).

MSSQ	Reported Nausea / Dizziness	Anxiety
10	None	None
16	None	Med
29.7	Low	Med
39.2	Low	High
51.5	Low	Low
75.3	Low	Med
81.1	Low	Low
93.5	Worried	Med
96.8	Low	Med
99.1	Low	Low

1. G. BarEla, L. Atid, S. Danos, N. Gabay, and R. Epelbaum. Art therapy improved depression and influenced fatigue levels in cancer patients on chemotherapy. *PsychoOncology*, 16, 11 (March 2007), 980-984.
 2. W. Breitbart and J. C. Holland 1993. Psychiatric aspects of symptom management in cancer patients. American Psychiatric Press.
 3. M. D. Wiederhold and B. K. Wiederhold. 2007. Virtual reality and interactive simulation for pain distraction. *Pain Medicine*, 8, s3 (September 2007), S182-S188.