

# D.I.Y. Position Tracking Add-on for Mobile AR/VR

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Figure 1: customizable controller add-ons



Figure 2: 3D drawing on mobile VR



Figure 3: stone balancing meditation in mobile VR



Figure 4: user tests

## ABSTRACT

REALITEER Corp. proposes a do-it-yourself add-on to integrate position tracking on mobile virtual reality devices. With this add-on, we can provide six degrees of freedom on most smartphone-based mobile VR systems (e.g. Google DayDream, Samsung Gear VR, etc.), enabling a wide variety of activities requiring hand manipulation. This controller add-on enables us to distribute therapeutic content that involves embodiment and hand-eye coordination to mobile VR users, which encompasses a larger population than desktop VR users.

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## CCS CONCEPTS

• **Computing methodologies** → **Computer vision problems**  
→ **Tracking**

## KEYWORDS

Virtual Reality, VR, wellness, psychiatry, marker, mobile

## ACM Reference format:

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## 1 PROBLEM TO SOLVE

Most current mobile VR devices lack position tracking for hand input. For example, the recently released Google DayDream comes with a controller that only provides three degrees of

freedom. This works as a pointer device, but fails to provide a hands-on experience like most desktop VR systems.

We propose a way to implement position tracking on mobile VR by utilizing the built-in smartphone camera. Combined with computer vision technology, we can provide six degrees of freedom tracking on mobile VR devices using only a few trackable markers, designed to be used alone or attached to linked controllers.

## 2 TECHNOLOGIES

### 2.1 Position Tracking

By analyzing the video feed from the built-in smartphone camera, we can obtain the transformation matrix of our markers relative to the camera, and then use the inverse matrix to draw the CG version of a user's hands from the CG camera. Because the calculations use a single, first-person point of view, no further calibrations are required - the CG hands are drawn in the exact positions as in real world.

### 2.2 Analog Trigger

RealControl can provide an analog trigger to enable common shooting and grabbing actions, just like common game controllers. We accomplish this by tracking another marker that is rigged to the first marker, and limited to only one degree of freedom (i.e. rotation in one axis). This information is used to calculate the angle between two markers and map the angle value to the trigger's magnitude.

### 2.3 Configurations

RealControl can work alone or in combination with 3rd-party controllers in the following configurations:

#### 1. RealControl + Google DayDream controller

In this configuration, we use one marker for transformation data, and use DayDream controller's orientation and button input. We also use the marker to calibrate the DayDream controller's orientation so that the user doesn't have to manually recenter every time before use.

#### 2. RealControl + BlueTooth clicker

In this configuration, we use one marker for transformation data, while incorporating the button signal from the BlueTooth clicker.

#### 3. RealControl alone

In this configuration, we use two markers, one for transformation data and another for the analog trigger.

## 3 CONTENTS

We collaborate with major hospitals, e.g. Stanford and Mount Sinai, to develop mental health improvement VR programs. Our mobile version contains art therapies in stone balancing and drawing.

### 3.1 3D Drawing

Drawing in 3D is the first feature we implemented with RealControl. It allows our users to create 3D art on mobile VR devices, similar to Tilt Brush or Quill on desktop VR. In this therapy, users can draw 3D shapes and dive into their own creations.

### 3.2 Stone Balancing

In the stone balancing meditation exercise, users deal with their thoughts, whether good or bad, one at a time. Users also learn to categorize their thoughts, for example, as a "judgement", "fact", "feeling", or "urge", by stacking and labeling stones. This helps the user develop a more objective point of view.

The original version of our software in collaborating clinics was developed for desktop PC with Oculus Rift + Touch because our exercises require embodiment with head and hand tracking. Unfortunately, this hardware configuration limits the number of users who can access our software.

With RealControl, everyone with a modern smartphone and spare cardboard can enjoy the exercises that we originally developed for commercial desktop VR systems, extending our service to a wider range of users. Importantly, this may improve access to individuals with lower socioeconomic status or in underdeveloped area, where mental health services are often underutilized.

### 3.3 Other Wellness Apps

REALITEER Corp. has developed and published six mobile apps in training, visualization, education and mindfulness. Working on these projects has given us the confidence to develop stable and consumer-ready VR content that can be used as mental health therapy.

## 4 LIMITATIONS AND FUTURE DEVELOPMENTS

The biggest limitation of using a built-in camera is that the field of view is limited to 40-45 degrees. This is sufficient for activities like stacking stones or drawing because the hands are always located where one is looking. However, this would not be ideal for activities that require a wider range of movement, such as sports. Some newer phones are now equipped with wide angle cameras or 180x180 degree cameras. Our technology can show its full potential when such hardware is more widely adopted.

Our mission is to use VR to improve people's lives by creating quality mental health, educational, and training apps that are affordable and accessible to everyone. With our tracking technology, we can implement features that are currently only available on desktop VR on mobile VR, allowing more people to enjoy and benefit from the power of virtual reality.