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# Demonstrating a Memory Orb — Cylindrical Device Inspired by Science Fiction

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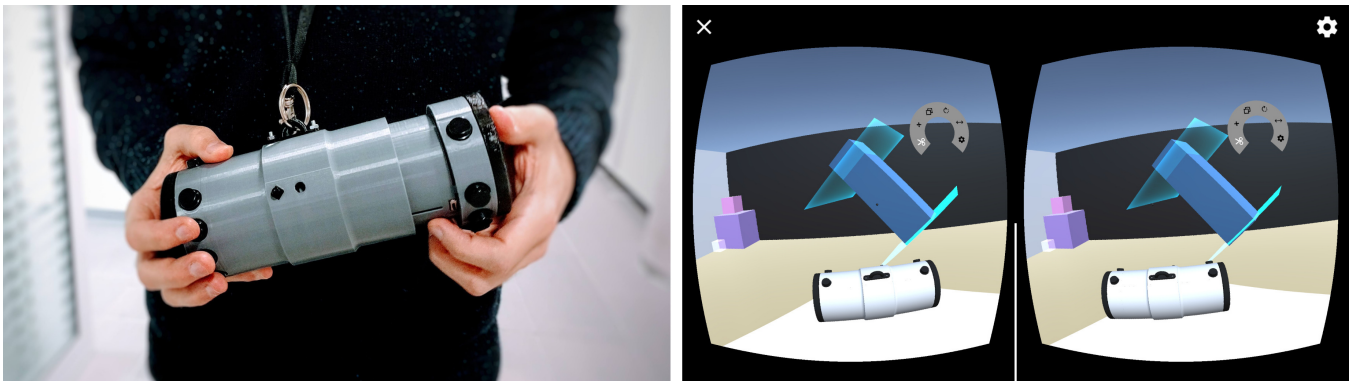

**Figure 1: A user holding a *memory orb* prototype and an in-game view of a simple virtual reality application exploiting the handheld device (made with the real-time development platform Unity 2021.1.23 and the Microsoft Mixed Reality Toolkit v2.7.2).**

## ABSTRACT

We present the design and prototype of a *memory orb*, a cylindrical device inspired from an artifact depicted in the science fiction movie Blade Runner 2049. The *memory orb* is a handheld input device, which allows users to control and manipulate three-dimensional, virtual content by combining pushing, pulling and rotating motor actions, facilitating muscle memory and eyes-free interaction. Our prototype integrates a large number of electronic components while maintaining a small form factor to allow ease of control and simple handling. The described implementation of this prototype aims to showcase the application potential of this cylindrical device in mixed, or virtual reality systems.

## CCS CONCEPTS

• **Human-centered computing** → **Interaction devices**; **Interaction techniques**; *Virtual reality*; *Mixed / augmented reality*.

## KEYWORDS

input device, cylinder, virtual reality, mixed reality, science fiction

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## 1 INTRODUCTION

The visualization of the technological future in modern science fiction (SF) has the potential to inspire real-world research and development endeavors [10, 13], including innovations in the field of human-computer interaction [9]. For instance, SF depictions of technology have sparked the exploration of novel devices [8], interaction paradigms [14], social robots [6] and facilitated the learnability and memorability of user-elicited gestures [1], to name a few.

With regards to novel user interfaces, the cylindrical shape as *the* primary interaction paradigm has been explored in recent years; examples are Magicscroll [7], HandLog [2], MagicWand [12] and the investigation of tactile feedback on cylindrical non-planar displays [3]. Cylindrical devices are both, well-adapted for human hands from an ergonomic perspective and well-known, due to their curvilinear, geometric shapes, adopted by many everyday objects (e.g. door handles or food, beverage and cosmetic products). This paper presents an SF-inspired cylindrical user interface based on a technological artifact found in the movie Blade Runner 2049 [15]. In the movie, the artifact is used in a mixed reality context by a worker, who is manipulating virtual (holographic) content while creating stories (memories); the device has initially been designed and conceptualized by Mike Hill and is described as a *memory orb*[1].

[1] https://www.mikehill.design/blade-runner-2049

## 2 CONCEPT AND PROTOTYPE IMPLEMENTATION

The *memory orb* presented in Figure 1 and 2 integrates a large number of electronic components while maintaining a small form factor and simple handling, thus, facilitating muscle memory and eyes-free interaction when used as a hand-held controller for augmented, mixed or virtual reality systems. The device is composed of two assembled cylindrical structures nested one inside the other, which allows simultaneous translation (up to 6 cm) and semi-circular rotation (up to 180°) between them. These physical transformations of the device are sensed by two potentiometers, respectively slide and circular.

Moreover, ten dome switches (one for each finger), two vibrating motors as well as two clickable and incremental rotary encoders (20 pulses per revolution) with 3D-printed circular caps, are positioned symmetrically on either side of the device, reachable for each hand. The momentary switches (buttons) afford multiple input modes as they can be pushed individually (for instance to validate an action), chorded together (combination of multiple buttons pressed simultaneously, resulting in 1023 possibilities) or even in conjunction with lateral, cylindrical transformations.

The rotary encoders allow for infinite rotation of their circular caps placed in the extremities and can be used for defining single values or value ranges (e.g., a minimum and a maximum). In addition, the caps also include a slight and smooth notch to ease their rotation with one finger (e.g., the thumb), accounting for human factors and hand ergonomics. The vibrating motors provide the user with controlled and nuanced tactile feedback, which can be used for action validation and error/alert transmission.

Internally, this *memory orb* comprises a microcontroller board (Arduino Nano RP2040 Connect), which includes a 6-axis inertial measurement unit (IMU) as well as both Bluetooth and Wi-Fi connectivity. The device is powered by a rechargeable 9V battery and a power switch is subtly placed on the inner cylindrical structure. Two prototyping printing circuit boards (PCB) with pin headers are included inside the device to handle and simplify the numerous electrical connections.

The outer cylindrical structure includes a slight flat surface, a screw and a stabilizer compatible with an optional VIVE Tracker [2] to ease the integration of the device in fully virtual worlds. The same structure also includes an optional opening to attach a wrist or neck strap securing manipulation of the device and allowing users to easily free their hands.

This *memory orb* is made of more than 34 components (excluding joints and wiring), 15 for the structure, 3D-printed with thermoplastic material and 19 off-the-shelf electronic components. The device has an overall diameter of 75 mm, a variable length of 173 mm — 233 mm and weighs 325 grams, including the battery and excluding the optional tracker.

## 3 DEMONSTRATION AND USE CASES

This demonstration introduces the audience to a new interaction paradigm and device — a prototype of a fully-functional *memory orb* — which can be used to explore mixed or virtual reality environments via three-dimensional manipulation (i.e., rotating, scaling, translating), selections and navigation actions. A basic proof-of-concept has been developed, in which: (1) the rotary encoders are used to navigate through a ring menu and select a range (by moving two planes) to cut extremities of a shape along one axis (Figure 1, right), and (2) the potentiometers are used to simultaneously zoom and rotate images (see accompanying video). In addition, we envision more complex use cases, briefly outlined below:

- *Computer-Aided Design (CAD).* Despite being made of a rigid structure, the mechanism of the device allows internal transformations (push, pull and rotate in one direction) that could be mirrored with a virtual content while designing 3D models. The direction is not fixed but defined and related to the virtual content by tracking the orientation of the device (either with an optional tracker or with the integrated IMU).
- *Video editing.* In-Headset virtual reality video editing has already been presented and tested with experts [11], yet while using traditional controllers (e.g., keyboard, mouse). In this context, a *memory orb* could be used to assist workers during video editing, for instance by providing a more tangible way to perform zoom, orientation, or even cuts by selecting the beginning and the end of a clip by rotating both circular caps.
- *3D imagery visualization.* In a similar fashion as the *Embodied-axes* [5], but bringing the advantage of mobility, a *memory orb* can be superimposed with a medical 3D imagery, offering embodiment to the visual manipulation of this virtual content.
- *Robotic control.* Augmented, mixed and virtual reality is already well explored in human-robot interaction (HRI) [16]. In this context, a *memory orb* could provide a novel way to interact with certain types of robots, in particular the two-wheel controlled vehicles and robotic arms, due to their physical similitude with the cylindrical characteristic of this handheld physical device.
- *Database/archive browser.* The infinite rotation of both caps in either side of the device offers (1) an analogy to navigating through a scroll and (2) a control to continuous stream of information [7], for instance to present items from digital archives. Besides, a *memory orb* could provide meaningful control to numerous interactive visualizations represented in cylindrical or even toroidal topologies [4].
- *Text entry.* A *memory orb* can assist text entry for headsets either by a two-handed chording method (each character assigned to a combination of pressed buttons) or by navigating through an already known QWERTY layout with the device physical transformation, in order to then select a character by pressing a button using the same finger that would be expected on a traditional keyboard, thus, potentially benefiting knowledge transfer.

[2] https://business.vive.com/eu/product/vive-tracker

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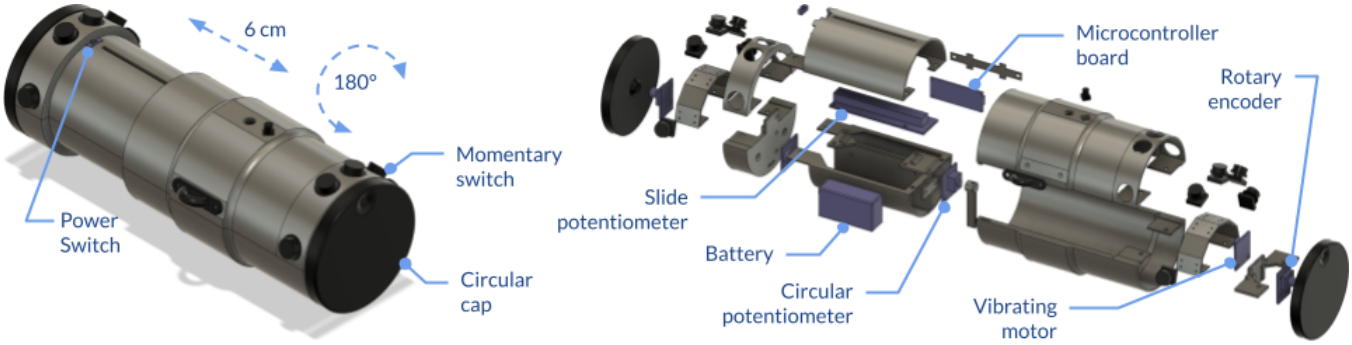


**Figure 2: Simplified 3D models of a *memory orb*, emphasis on the interactive parts (left) and internal electronic components (right).**

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