# Ball20: An In-Hand Near-Spherical 20-Sided Tangible Controller for Diverse Gesture Interaction in AR/VR

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#### It rolls. It senses pressure. It recognizes gestures.

**Ball20** breaks the sphere's limits with near-spherical **20** pressure-sensing faces, redefining what a spherical controller can do.

#### **Ball20 Software**

✓ Force-based recognition with

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## **Ball20 Hardware**

✓ Spherical interfaces: intuitive, but limited input

experimentally predetermined thresholds (e.g. >1.4N for contact, >6N on opposite fases for >0.5s for Opposite Press, etc.)



- ✓ **Dual-mode** gesture system
  - ✓ **Neutral Mode**: Free roll, quick gestures
  - ✓ **Three-Finger Mode**: Diverse gestures
- ✓ Mode switch via Three-Finger Grip



## **Drawing Application**

#### ✓ Ball20 turns each face of an icosahedron into an input channel



#### User Study 1: Usability Exploration in Drawing Application

✓ Tasks: Gesture training  $\rightarrow$ Drawing scenario training  $\rightarrow$ <u>Free drawing</u> → Interview



#### (2) Creating Spheres and Drawing with a Brush

#### (1) Grabbing and Releasing an Object



(3) Scaling



(4) Copy



(5) Erasing / Undo







- Supports diverse & expressive interactions Ø for VR drawing application
- Haptic feedback, visual icons, and gesture Ø guides enhanced user experience

- Users successfully used Ball20 for object manipulation and drawing
- Smooth rolling + Natural & intuitive gestures (e.g., index for draw, thumb for undo)  $\checkmark$ 
  - Nice material and grip posture
  - Lack of tactile feedback when pressing
  - Further simplification of the gesture set and consistent mapping

#### **User Study 2:** Quantitative Evaluation of Ball20's Usability

- ✓ Tasks: Same training  $\rightarrow$ <u>Replicate sample drawing</u>  $\rightarrow$ Interview & Survey
- ✓ Improvements from Study 1: Haptic feedback, Brush icon, In-VR gesture guide



**676.5s** *(SD = 70.14)* to complete the task

- **SUS 65.25** (slightly below the center of the curved grading scale)

#### **Order** Proved **spherical tangible devices** can act as general-purpose input controllers for 3D UIs

