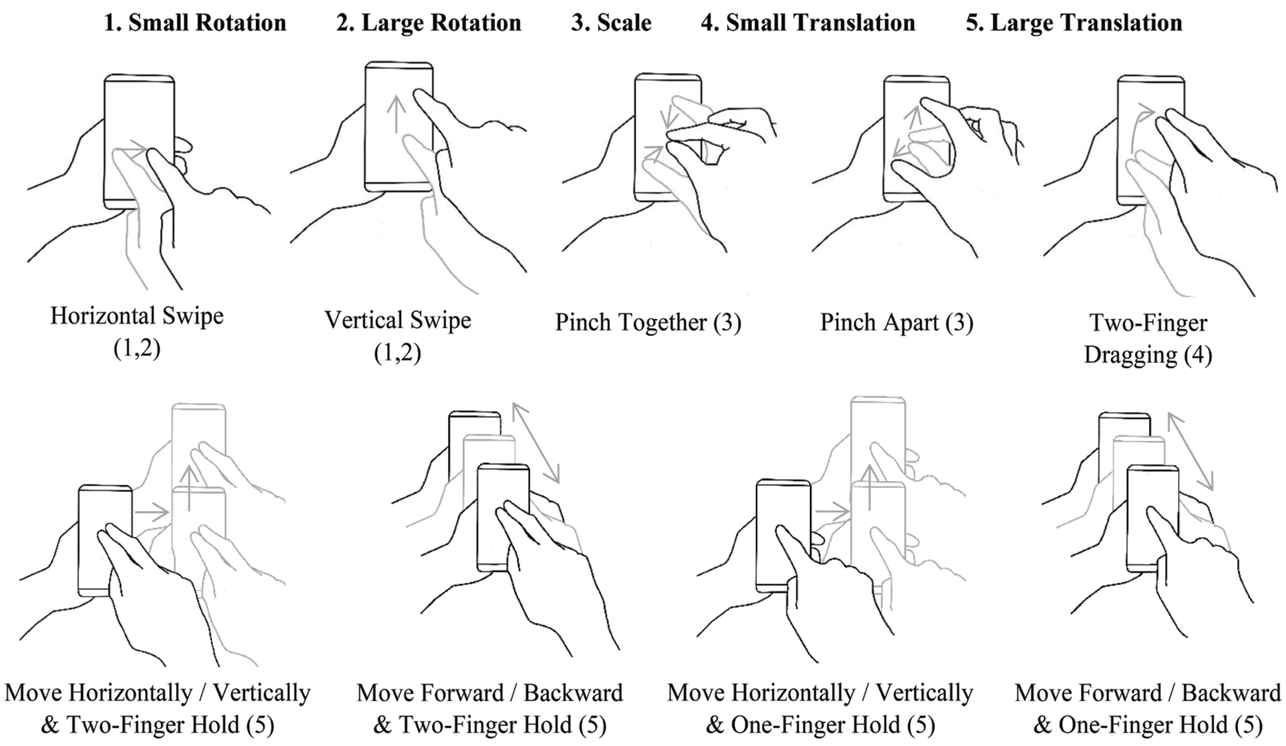
User-Elicited Surface & Motion Gestures for Object Manipulation in Mobile Augmented Reality

Background & Motivation

Existing MAR interaction techniques for manipulating virtual objects often vary in design and level of control. Specifically, prior work developed 6DOF manipulation methods using only 2D surface gestures, however these require the use of complex multi-finger gestures, resulting in less engaging interactions. Considering this, is it possible to design a non-widget 6DOF interaction system supporting both precise and coarse manipulations in MAR?

Our work demonstrates how surface and motion gestures can be combined in different ways for both precise and coarse manipulations, and that user mobility can act as an implicit indicator for degrees of freedom separation.

Gesture Consensus Set



Touch+Move Interaction Technique

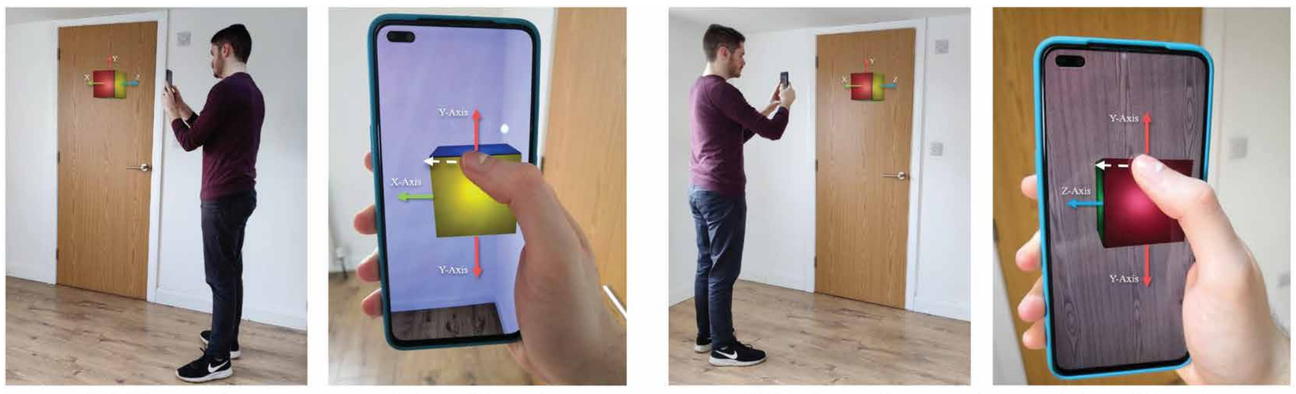
We developed a Mobile AR technique combining the gesture **consensus set** and **user mobility** for implicit DoF separation. This allows users to have granularity when manipulating objects, without relying on complex, multi-finger gestures or widgets.

The Touch+Move interaction technique:

- **A)** Three regions of interaction
- **B)** Large and small rotational interaction
- **C+ D)** Small and large translational interaction
- **E)** DOF separation via user mobility

Future Work

A clear avenue for future work is to further consolidate our consensus set with more participants, following 'closed elicitation' to eliminate conflicting gestures or yield additional gestures. While we assert that Touch+Move could perform better than pre-existing techniques, a clear next step is to evaluate this hypothesis through a comparative evaluation.



(1) Translate along X or Y axis

(2) Translate along Z or Y axis

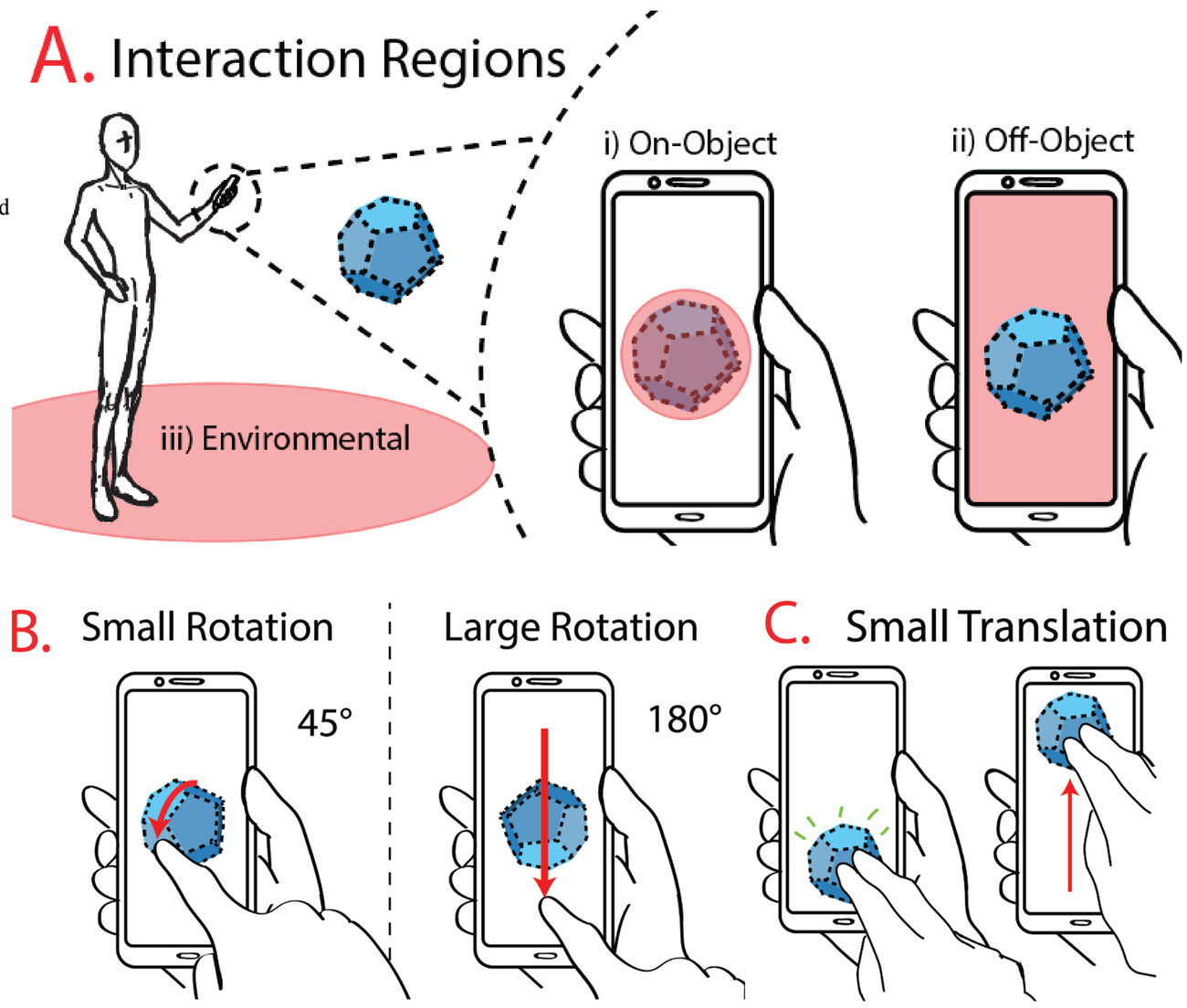
Touch+Move Interaction Technique

Gesture Elicitation Study

We follow previous elicitation methodology to collect user-elicited motion and surface gestures for 3D object manipulation on smartphones. A total of 8 participants (5 male) were recruited, with participants eliciting gestures with their own mobile devices. Participants created gestures for 6 different manipulation tasks:

- **Translation**: Short (within FoV) / Large (outside FoV)
- **Rotation:** Small (45°) / Large Rotations (180°)
- **Scale:** Uniform Scale (2x Larger)
- **Mixed:** Translate, Rotate, & Scale uniformly

The elicitation study produced 48 gestures across the 6 tasks, resulting in a **gesture consensus set** which was the basis of our Touch+Move Interaction.



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