## AnimHands: Creating Opportunistic Interfaces with Hand Gestures in Augmented Reality

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Internship period: start March 1st or April 1st (5-to-6 months) Supervisors: Caroline Appert, Olivier Chapuis, Emmanuel Pietriga Research team: ILDA, Inria (Université Paris-Saclay, building 660, Gif-sur-Yvette)





(Left) A soda can turned into a music player [ZSF20]. (Right) A mug turned into a slider to control ambient light intensity [FXJ23]

Most Augmented Reality systems (e.g., Meta Quest 3 or Apple Vision Pro) can reliably track users' gaze and hand movements. They can also scan the environment to detect uncluttered, flat surfaces like walls and tables. However, they still struggle with the real-time tracking of physical objects or surfaces that are cluttered. This is a limitation that prevents the development of opportunistic interfaces where users could turn any object around them into a user interface. The HCI literature envisions such opportunistic interfaces [HEF08], with, for example, a soda can turned into a music player or a mug turned into a slider to control ambient light (see Figure above).

Some solutions exist to track objects in AR but they either involve adding markers to objects and surfaces [KBP00], or training the system with some knowledge of objects to track (e.g., [APP24,JSD23]). These methods come with significant costs such as instrumenting objects, acquiring data, implementing complex and resource-intensive recognition and tracking algorithms. An alternative consists of relying on hand tracking to detect hand activities that are specific to object manipulations and surface contacts. For instance, GripMarks [ZSF20] recognizes grasp postures that are specific to some objects but it works with a predefined set of objects only and still requires prior training.

In the ILDA team, we are working on alternative approaches that rely on hand activity tracking to detect object manipulations and surface contacts. Unlike methods that require object instrumentation or prior training, our approaches allow for real-time, opportunistic interactions without depending on predefined objects or user-specific data. Previous work like GripMarks [ZSF20] has explored similar methods, but these were limited to predefined objects and required prior system training. We have already developed techniques to track surfaces [DAR24] and objects [BAC\_] through hand activity alone, but these methods still face challenges. Specifically, while our system can track the location of objects based on hand activity, it cannot yet infer the

precise geometry of objects. This means the system cannot accurately map user interface elements, such as sliders or buttons, onto the object's surface.

In this internship, we aim to overcome this limitation by designing hand gestures that provide the system with object geometry information. These gestures will go beyond the simple grip gestures and hand taps we currently rely on, considering two-handed actions and continuous movements. These gestures should be simple to perform yet provide some information to the system about the object so that it could map interactive pads, sliders and buttons on its surface. The candidate will work on the design and implementation of such hand gestures to support the implementation of opportunistic interfaces. The candidate will work with both the supervisors and the two PhD students from the team who have developed surface [DAR24] and objects [BAC\_] tracking techniques that are based on hand tracking only.

## Bibliography

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