HoloLens is more than Air Tap: Natural and Intuitive Interaction with Holograms

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ABSTRACT

Augmented Reality (AR) is becoming more and more popular and many applications across multiple domains are developed on AR hardware such as the Microsoft HoloLens or similar Head-Mounted Displays (HMD). Most of the AR applications are visualizing information that was not visible before and enable interaction with this information using voice input, gaze tracking, and gesture interaction. However, to be consistent across all applications running on an AR device, the gestures that are available for developers are very limited. In our use case, using a Microsoft HoloLens, this is just an Air Tap and a Manipulation gesture. While this is great for users, as they only have to learn a defined amount of gestures, it is not always easy for developers to create a natural interaction experience, as the gestures that are considered natural, depend on the scenario. In this paper, we are using an additional sensor, a Microsoft Kinect, in order to allow users to interact naturally and intuitively with holographic content that is displayed on a HoloLens. As a proof-of-concept we give five examples of gestures using natural interaction for HoloLens.

ACM Classification Keywords

H.5.2. Information Interfaces and Presentation (e.g. HCI): User Interfaces

Author Keywords

Augmented Reality; Gesture Interfaces; Head-mounted Displays; Natural Interaction;

INTRODUCTION AND BACKGROUND

With the proliferation of Microsoft HoloLens, a new generation of head-mounted displays (HMDs) has arrived on the market. These HMDs have the capability of creating a spatial model of the environment and to detect a number of gestures to enable natural user interaction with content that is presented on the HMDs and with connected IoT (Internet of Things) devices. However, due to a mixture of hardware limitations and unified interaction design, only a limited number of gestures are available for these devices: in case of the HoloLens, this is an Air Tap gesture and a Manipulation Drag gesture. However, natural interaction cannot be limited to just two types of available gestures. Creating a natural user interaction experience is highly dependent on the application that is being used. Some applications might need touch interaction, others might need kick interaction. Therefore, we are asking the question: Why are other natural interaction possibilities not available for state-of-the-art Augmented Reality (AR) devices?

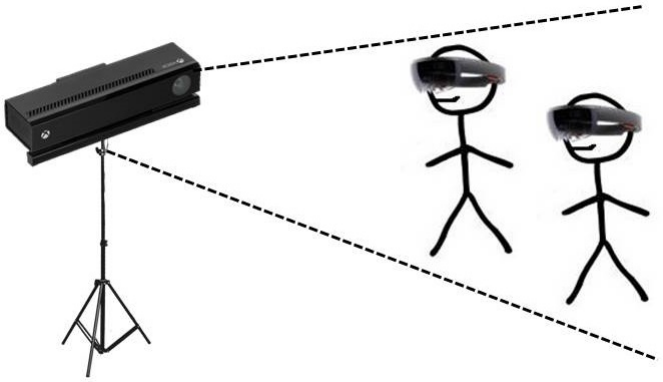

Figure 1. Our system uses a stationary Microsoft Kinect to enable natural interaction with Holograms.

This trend is also very surprising as previous research found promising possibilities for natural interaction in AR applications. For example, gestures for AR applications have been proposed before by Buchmann et al. [1]. Further research revealed the best gestures according to users [3]. Another project showed that these gestures differ according to the distance to the interaction object [2].

Another aspect of interacting with holograms on HMDs is that when the users' hands are not visible to the built-in gesture sensor, the gesture is not seen by the system which might not feel very natural. This aspect can be changed by using an optional external sensor in addition to the built-in sensor to further increase the interaction capabilities of the HMD.

In this paper, we combine a Microsoft Kinect with a Microsoft HoloLens to enable a full body interaction with holograms. This enables natural interaction on state-of-the-art AR devices and increases the gesture sensing space of HMDs. We present a proof-of-concept implementation and present five different interaction types that are possible with our system.

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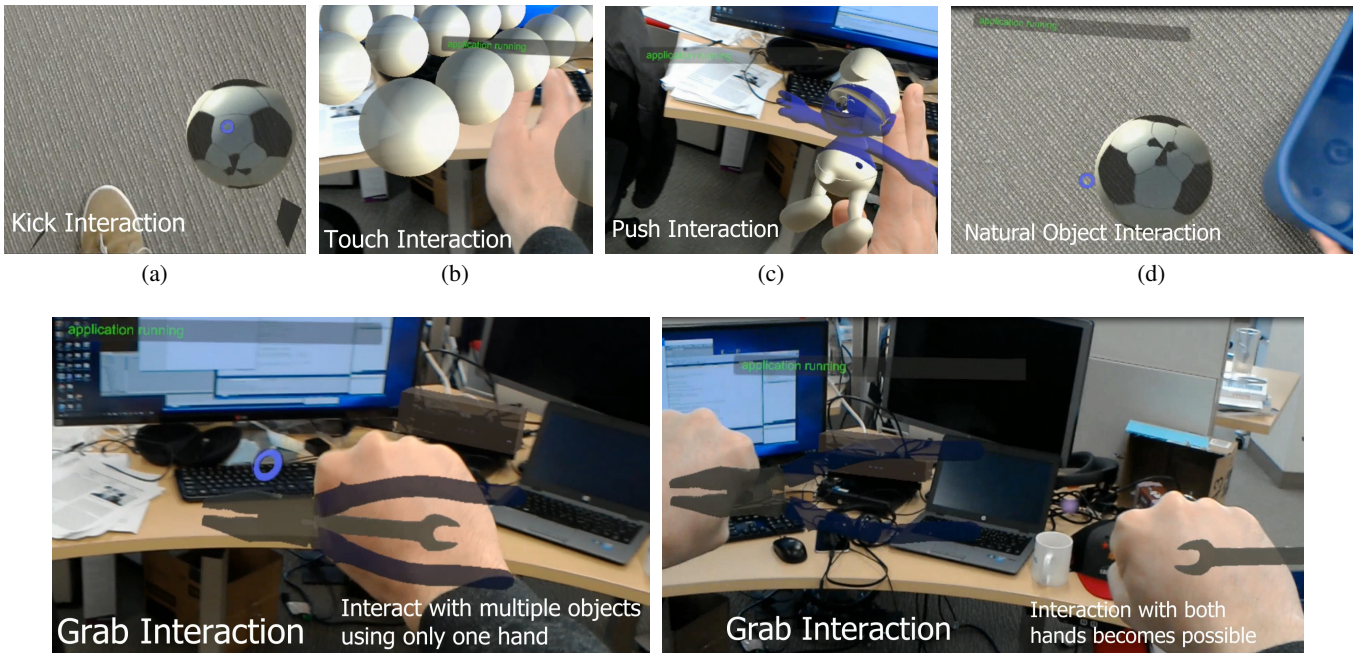

Figure 2. The different natural gestures that are possible by combining a Microsoft HoloLens with sensor input from a Microsoft Kinect.

EXTENDING GESTURES WITH EXTERNAL SENSING

In order to overcome the lack of interaction possibilities, we combine a Microsoft HoloLens with an external Microsoft Kinect. In our proof-of-concept implementation, we stream both skeleton data and a scaled down version of the depth-image to a HoloLens. The HoloLens then treats the depth data as a physical object and enables a simple interaction using Unity's physics engine. In our proof-of-concept implementation, we implemented the following five gesture types (also shown more extensively in our video[1]):

Kick interaction: Users can kick virtual objects and interact with objects using their feet (see Figure 2a). In our demo, we built a soccer ball scenario to kick a virtual ball.
Touch interaction: Users can further touch virtual objects with their hands. On touch, an action is triggered on the object. In our case, it falls down (see Figure 2b)
Push interaction: Another way of naturally interacting with an object is to change its position by pushing it in a direction. As shown in Figure 2c, we implemented pushing a virtual smurf.
Real object interaction: When real-and virtual spaces merge, holograms should also be able to interact with physical objects. In our demo implementation, we kick a virtual ball with a physical recycling bin (see Figure 2d).
Grab interaction: Ideally, we would move objects by grabbing them and releasing them again after we found the correct position. We implemented a scenario in which a user can do exactly that either using one hand (see Figure 2e) or simultaneously using both hands (see Figure 2f).

[1]Video Link: https://www.youtube.com/watch?v=HK-GISjiFLs

CONCLUSION AND FUTURE WORK

We introduced a way to extend the interaction capabilities of a Microsoft HoloLens by including the data of an external Microsoft Kinect. We argue that interacting with virtual content on HMDs can be made more intuitive by introducing another sensor. The position of the external sensor is not specific for a particular user and could even enable multi-user interaction. Further, the interaction in this system setup does not require users to learn new gestures or to memorize specific commands. In our proof-of-concept implementation, we introduce five different gestures to naturally interact with holograms, however there are many other ways of using this setup for sensing other gestures. Our future work will focus on further evaluating this concept with various stakeholders using AR and discuss emphasis on natural interaction for stakeholders with different interests, e.g. service technician vs. 3D model reviewer.

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