

CMSC 498W Lecture 13  
“User Interaction”  
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You may ask why special interaction techniques are needed for VR and AR- or, in other words, why aren't the standard keyboard-and-mouse or gamepad good enough. There are essentially two reasons.

First, for immersive VR, it's desirable to include the Kinesthetic sense; this can be done by using a controller where the user's body motions mimic, or are at least close to, the motions being made by the user in the virtual world.

Second, VR and AR applications often require controlling an object in a 3D space, while controllers like mice or thumb-sticks offer only two degrees of freedom. This is fine for moving an object on a 2D plane, such as a monitor screen or the ground in a virtual world, or even for rotating a 3D object, but is not sufficient for moving an object in 3D. A keyboard can accomplish this, but the keys are not analogue and pressing buttons to move an object in 3D can be unintuitive.

One common type of 3D interface tracks an object being held in the user's hand. An example of this is the Wii Remote Plus, which uses gyroscopes and an accelerometer to detect 3D translations and rotations of the controller. Another example is the PlayStation Move controller, which has a lighted ball on the end which is tracked by a camera (distance is determined by the size of ball in the image); the controller also contains an accelerometer and other motion-sensing hardware.

The controllers that come with the HTC Vive and the Oculus Rift, as well as the headsets themselves, are also motion-tracked, through the use of infrared light. In the HTC Vive's “Lighthouse” system, pulses and sweeping beams of infrared light are emitted by two base stations and detected by infrared sensors on the controllers and headset. In the Oculus Rift's “Constellation” system, patterns of infrared LEDs on the controllers and headset are detected by infrared sensors in one or two base stations.

Another common type of interface tracks the user's body using cameras. Examples of this are the PlayStation Camera, which simply uses two cameras, and the Xbox Kinect, which uses an RGB camera, an infrared camera, and an infrared laser projector which projects a grid pattern onto objects. The Kinect uses software which can track users, recognize gestures, and segment users' bodies into joints. The algorithms used to do this can be significantly complex.

The Leap Motion controller uses similar technology, with two infrared cameras and infrared LEDs, but covers a much smaller area, suitable for tracking a user's hands.

Tracking head translation and rotation, as is done by VR headsets such as the HTC Vive and Oculus Rift, is also a type of user interaction.

For VR applications, it is generally desirable for the motions that the user is physically making to match the motions being made in the virtual world. For AR applications, however, the user's motions can be more abstract.