Gravity Pen

Create a device to simulate gravity in Virtual Reality.

A weighted inner rod moves in and out of a hollow tube, to be held in the hand like a pen.

When a virtual object is picked up, the interior rod moves outward to increase the moment of inertia and create the sensation of a weight hanging off the tip of the pen.

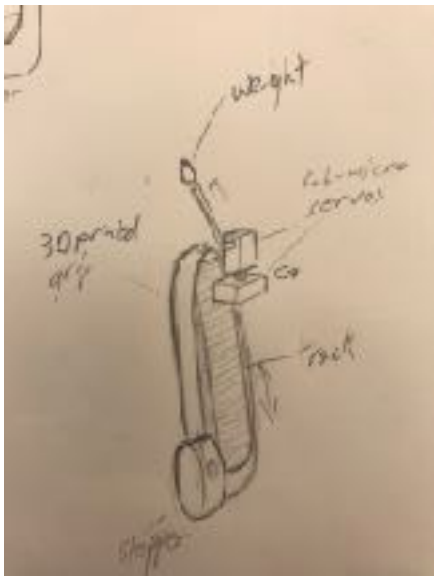
When the virtual object is released, the rod retracts into the pen and the weight becomes balanced in the hand, feeling significantly lighter than before.

The weight can potentially be moved and stopped at precise times to jerk the pen, creating a sensation of hitting a virtual “obstruction”.

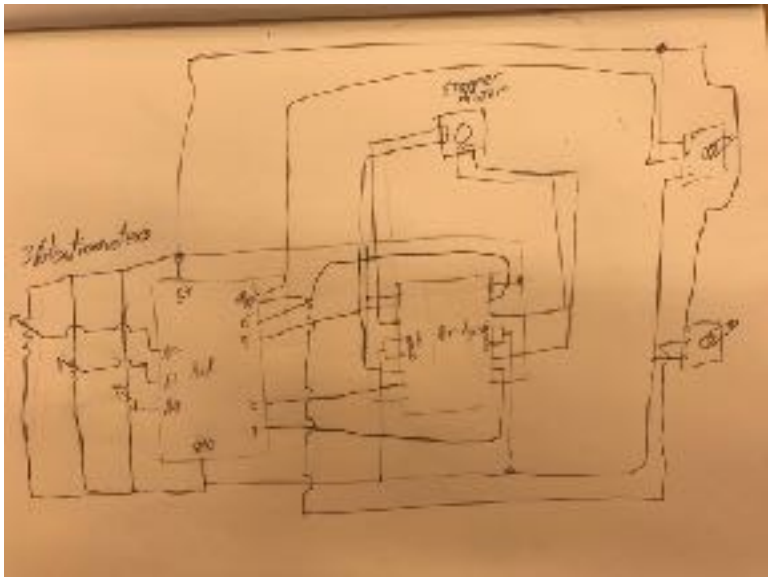
A light can be used to simulate a virtual object. When the pen is moved into the field of light, a light sensor will trigger to move the weighted rod outward.
A more complex version would be to connect the pen to a virtual world. This would require a series of highly accurate sensors to detect location of the pen, and map it into the virtual world, so it can interact in that space.

Prototype will be made using a stepper motor and track to move the weight in and out. The motor will need to be mounted conveniently and all parts consolidated to the center of gravity so as not to interfere with the weighted end’s effect on the pen. A printed circuit board will help to limit the number of wires needed.

The weight should be held somewhat parallel to the ground, independent of how the pen is held, in order to maintain a consistent torque felt in the hand.
This can be achieved by attaching 2 small servo motors to the printer track. Each motor will provide an axis of rotation to maintain the position of the weight.



Drawing of the Pen
The first prototype will be tested using 3 potentiometers to control the stepper motor and 2 servo motors, as shown in the below schematic:



This will allow me to test the wiring and mechanics before diving into the code.

The final project will use accelerometers and a 3-axis gyroscope to measure the angle and motion of the pen. Readings from these sensors will inform the angle and motion of the servo motors.

Other materials may include light sensors, distance sensors, accelerometers, pressure sensors, and buttons, in order to control the motion and attitude of the weight.

Another possible interaction to explore is the experience of “throwing” a virtual object, using the servo and stepper motors in concert to swing the weight in the direction the pen is moved. If coordinated smoothly, and the weight is retracted back into the body of the pen, it will feel as if the weight as left the hand.

Potential problems will most likely arise from difficulties in communicating between the real world and the virtual object, as well as difficulties in detecting position and orientation of the pen itself. Redundant sensors will be necessary to accurately perform this function.

The minimal viable project will avoid these issues by using light sensors and a light source to simulate interaction with a virtual object, and a gyroscope to approximate pen angle.