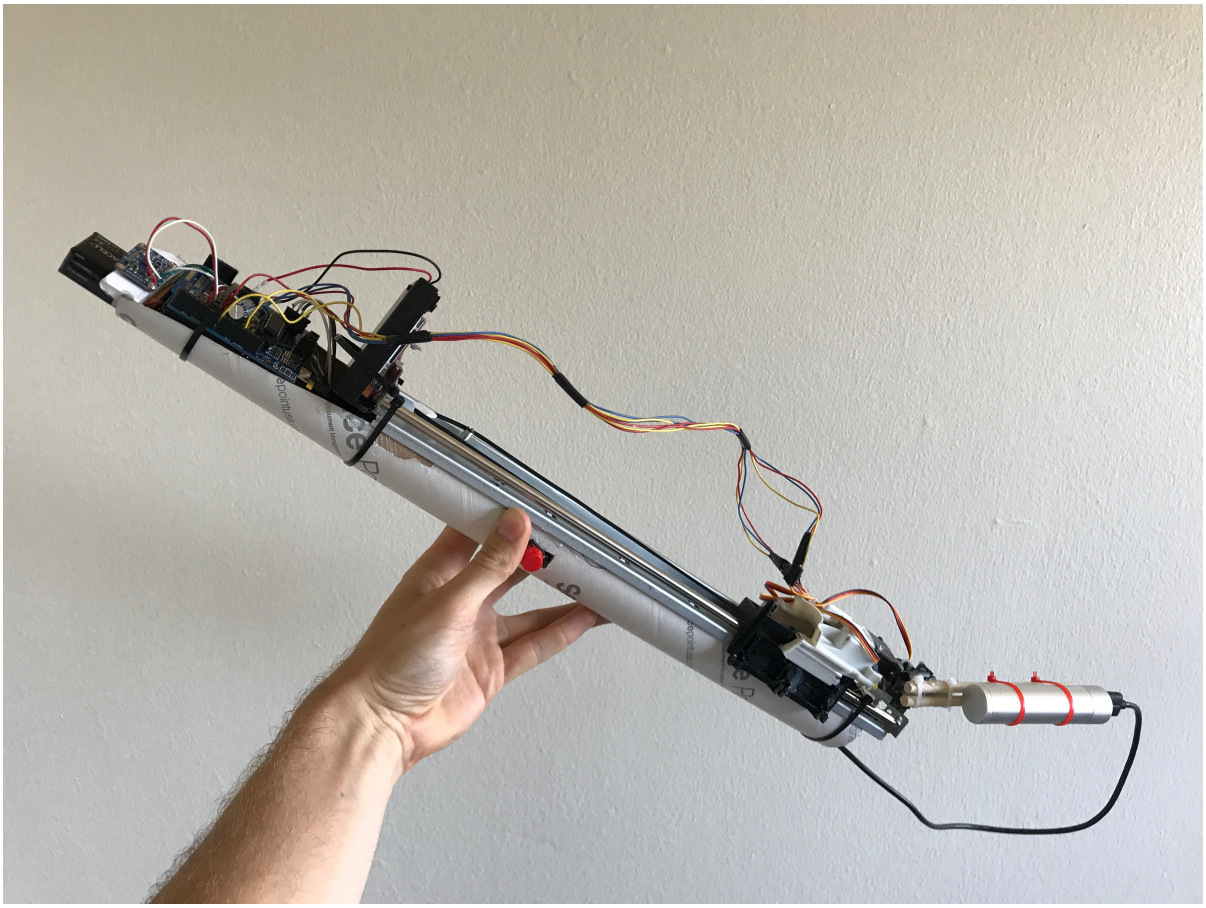
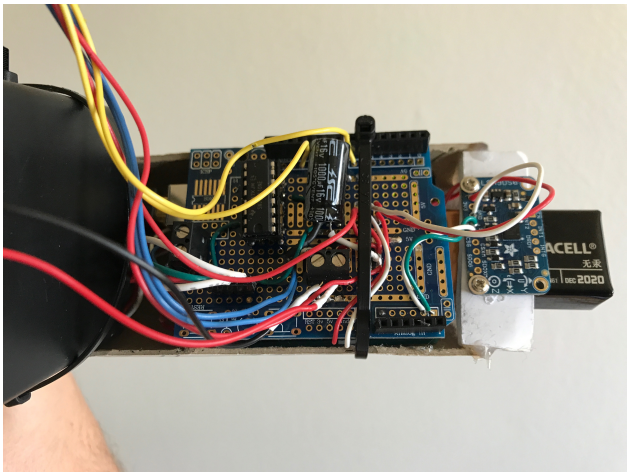
Gravity Pen

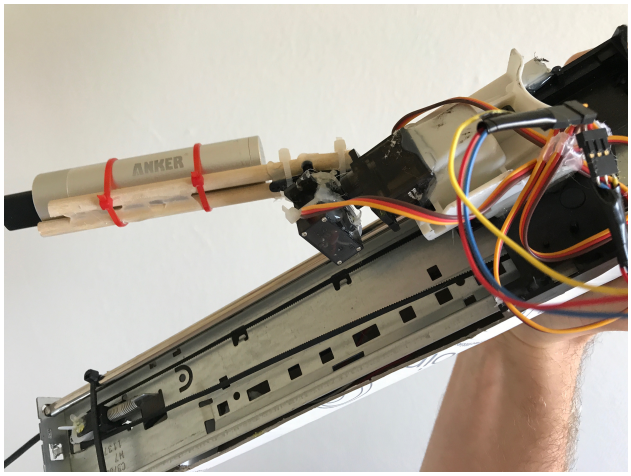
Jon Simmons

The Gravity Pen gives substance and physical feedback to the otherwise ethereal world of Virtual Reality. By manipulating a weight (currently the battery), the pen's moment of inertia changes, which can create the sensation that a virtual object is actually hanging off the tip of the pen. In order to ensure that the sensation does not change when the pen is held vertically (when the moment of inertia would be the same whether the weight is extended or retracted), the weight is maintained level to the ground.

The weight is extended on a printer track, using a stepper motor. In order to maintain the weight's level, a 9 DOF sensor, which includes an accelerometer, gyroscope, and magnetometer, constantly monitors the pen's pitch, roll, and yaw. This data is fed to two servo motors, which correspondingly react to the pen's movements and keep the weight level.



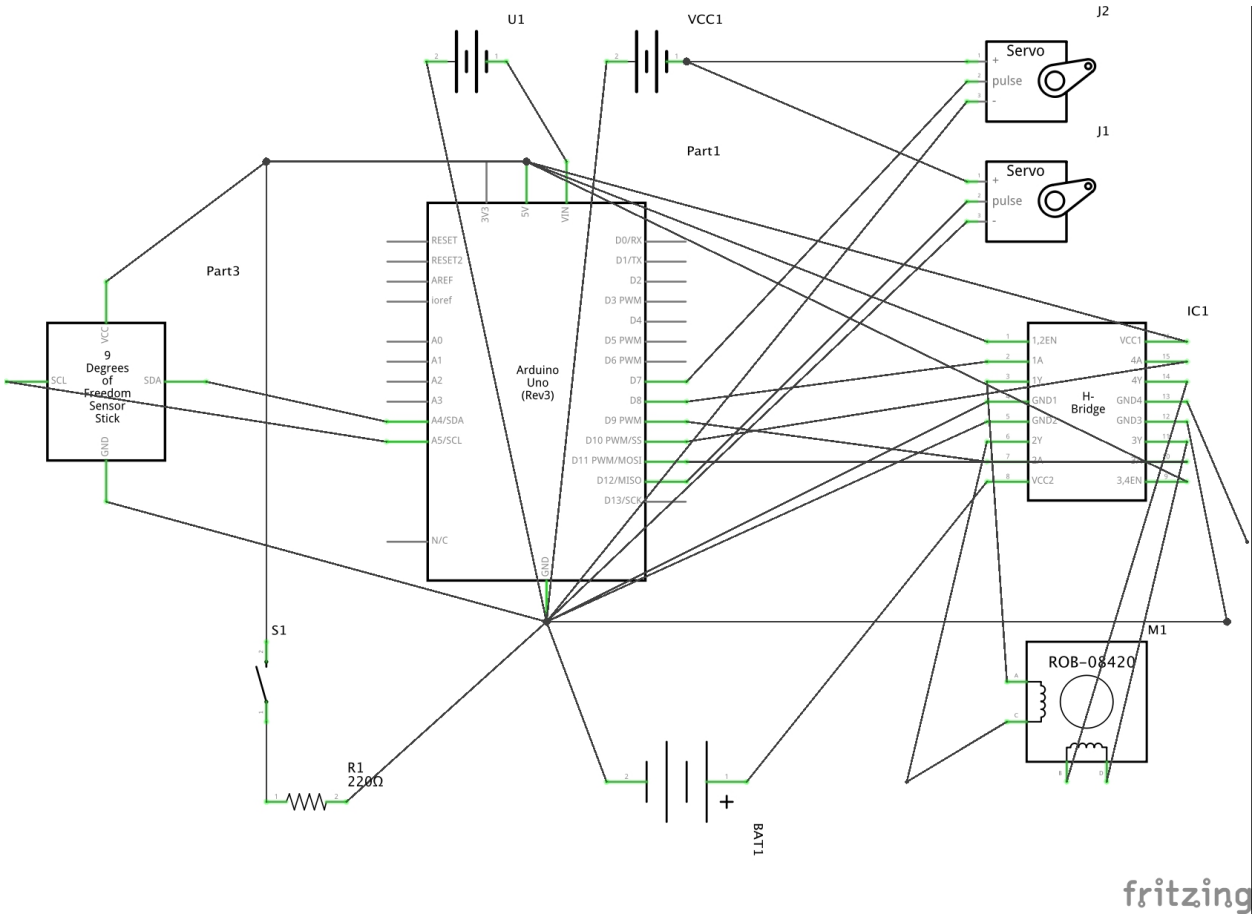




Parts list:

- 9 DOF Sensor - Adafruit LSM9DS0: includes an accelerometer, gyroscope, and magnetometer, which collect raw data about the pen's movement and location in space
- 2 Servo Motors - Tower Pro MG90S Micro Servos: These are high-torque, miniature servos with metal gears. They are strong enough to hold the weight consistently without excessive strain, and the metal gearing stands up well to the inevitable wear and tear of their function.
- 12V stepper motor
- 3000 mah, 5V Lipo battery - delivers consistent power to the Arduino board, which in turn powers the button and 9 DOF sensor
- 9V battery - powers the stepper motor
- 4AA batteries (6V total) - powers the two servo motors
- Arduino Uno

Schematic:


U1
VCC1
J2
Servo
pulse
J1
Part1
Servo
pulse
Part3
IC1
RESET
RESET2
AREF
Ioref
A0
A1
A2
A3
A4/SDA
A5/SCL
N/C
3V3
5V
VIN
GND
D0/RX
D1/TX
D2
D3 PWM
D4
D5 PWM
D6 PWM
D7
D8
D9 PWM
D10 PWM/SS
D11 PWM/MOSI
D12/MISO
D13/SCK
Arduino
Uno
(Rev3)
VCC
SCL
SDA
GND
9
Degrees
of
Freedom
Sensor
Stick
1,2EN
1A
1Y
GND1
GND2
2Y
VCC2
VCC1
4A
4Y
GND4
GND3
3Y
3,4EN
H-
Bridge
S1
M1
ROB-08420
R1
220Ω
BAT1
+
fritzing