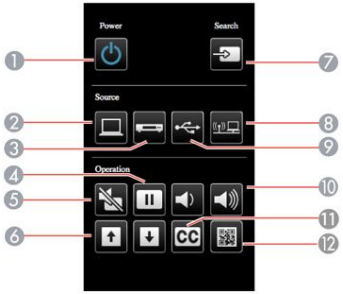
Use Cases

What is the device going to do? What problem area are you trying to improve? Be specific and describe exactly how far you will go with your implementation. You should also list the multiple ECE Areas that your project will cover.

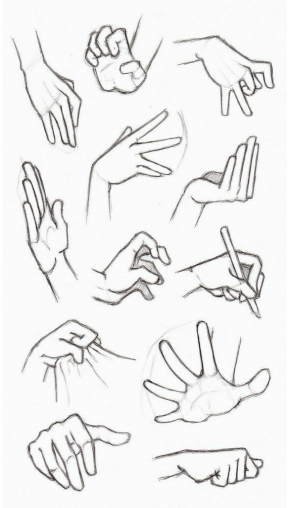
- Mac attachment that will turn any screen into a interactable wall projection
- Problem Areas:
  - Online Education ➔ e.g., Drawing on a screen without pen device is inaccurate
  - Small Screen Space ➔ Any smaller laptop screen can be made larger via projection
- ECE Areas:
  - Software Systems: Openpose, calibration, tracking
  - Circuits: Creating the pen

Requirements



Input

- Pen: Left/Right click using button ➔ Mimic Mac laptop mouse
- Pen: Left click drag ➔ Mimic laptop mouse drag
- Pen: Mouse hover within 6 in from the wall ➔ Mimic laptop mouse hover
  - 6 inches distance for the pen to still be considered active
- Body Expressions: (3 default, can create/edit custom gestures)
  - Hand swipe for back or next page
  - Hand swipe up for close tab
  - Slap wall for refresh
  - Programmable if the user wants to use different shortcuts/macros
- Computer: Interact with system through GUI
  - modify gestures
  - Enter calibration mode (?)



Requirements

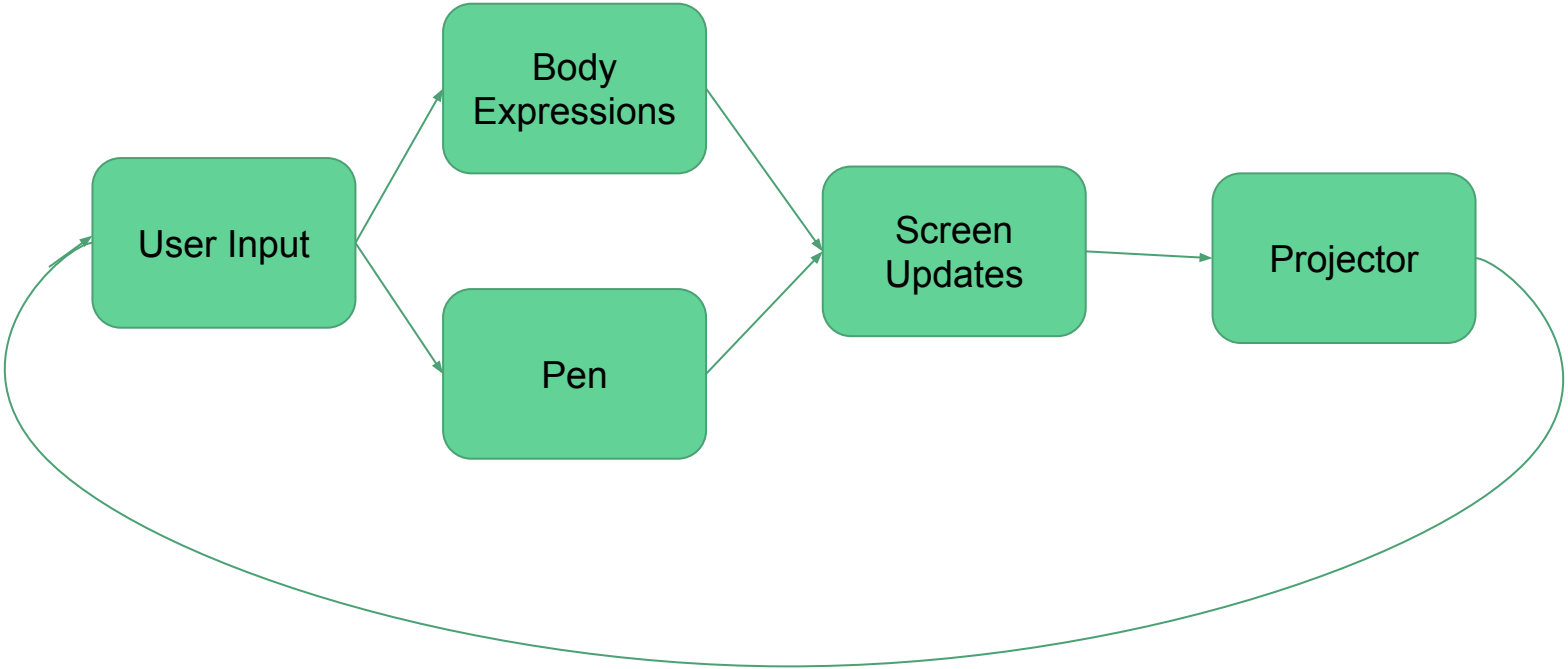
System technical specs

- Projections within 10 ft for 1280x1024 projection resolution
  - 10 ft: average room distance
  - 1280x1024 average projector resolution
  - Distance from wall -> adjustable screen size, just need to calibrate
- Meant for indoor use (lighting reasons)
  - Outdoor has different requirements (much much brighter, too much power)
- Response time of x/(200) ms (change on projector)➜ smooth user experience (without lag)
  - Open pose response time to calculate body pos
  - Bluetooth connection speed
  - Time to update projector display
- Polling rate of x/(50)Hz
  - Open pose response time to calculate body pos
  - Bluetooth connection speed
  - Time to update projector display
- Calibrate pen and project to accommodate different screen sizes and distances from wall
- macOS (logistical reasons)
  - 9 calibration points 3x3 (gets the entire screen size)
- Open Pose gesture recognition 95% accuracy
  - allow room for realistic error, but gesture accuracy is important
- Projector on initial startup/move positions ➜ Enter calibration mode and calibrate with pen
  - Calibration is analogous to smartboard calibration
  - User clicks with the pen in preset locations

Technical Challenges

- Fast enough response time for a smooth user experience
  - OpenPose can only be run effectively on an Nvidia GPU ➜ May need to send data to remote lap computer to be run and have results relayed back to laptop
  - macOS does not run on an Nvidia GPU
  - Requires large amount of processing power
- Creating a small enough pen for a good user experience
  - Arduino parts are bulky
  - Hard to organize well into good ergonomics
- Teamwork while remote can be challenging
  - Assembling multiple moving parts of system
  - Difficult to divide labor effectively

Solution Approach



Solution Approach

Pen

- Arduino Pro Micro/Arduino Leonardo with MPU6050 gyroscope/accelerometer and HC-05 bluetooth as well as buttons/switches
- Software functionality to use the accelerometer/gyroscope readings to keep track of the pen's position in 3d space and update the cursor accordingly
- Software functionality to take in the button inputs and translate them to mouse events

Projector

- LCD projector (more affordable) that has good enough resolution to relay laptop screen onto wall clearly
-

Computer System

- Open Pose for body expressions
- GUI for calibration and projector relay information
- Bluetooth connect to computer for pen

Testing, Verification and Metrics

Pen

- Bluetooth works
- Test hover .5-6 inches away
- Test left/right click
- Test drawing
- Test click/tap

Projector/System

- Projections within 10 ft for 1280x1024 projection resolution
- Response time of x/(200) ms (change on projector)➔ smooth user experience (without lag)
- Polling rate of x/(50)Hz
- Calibrate pen and project to accommodate different screen sizes and distances from wall
- macOS (logistical reasons)
    - Try multiple distances from 5 ft-10 ft
    - Move projector after calibration, recalibrate

Open Pose

- Generic test for 3 default positions (5 tests per position, with different users)
- Add custom tests, test real time if it works with different people

Tasks and Division of Labor

Jenny

- In California right now, going to come back sometime around March
- Will work on OpenPose stuff while remote
- Work together on pen + projector+system when back

Jade

- In Pittsburgh, assemble/test pen with Bradley
- Connect projector to laptop
- Wire bluetooth piece to connect with laptop

Bradley

- In Pittsburgh, assemble/test pen with Jade
- Work on calibrating and using sensor readings

Schedule

- First priority
  - Laptop: Connect projector to laptop, Relay screen info onto laptop, relay outside mouse clicks to laptop
  - OpenPose: Download and set up/ get position tracking
-