Interactive Secure Headset

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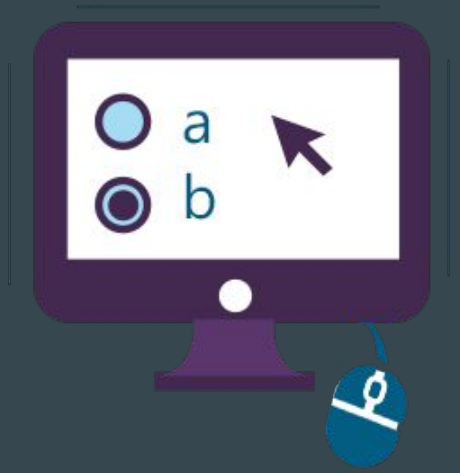
Problem Statement

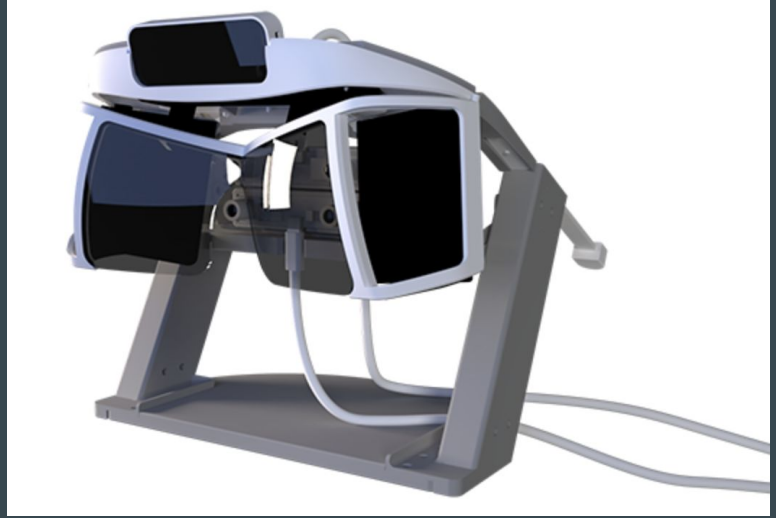
- Testing is important
  - Used in varied aspects of professional or academic life
- Problem
  - Current testing solutions for online exams are vulnerable to cheating
    - Cameras can record the exam
    - Test taker could have additional material outside of camera view
- Solution
  - A full enclosed head mounted display that connects to testing server



Market Survey

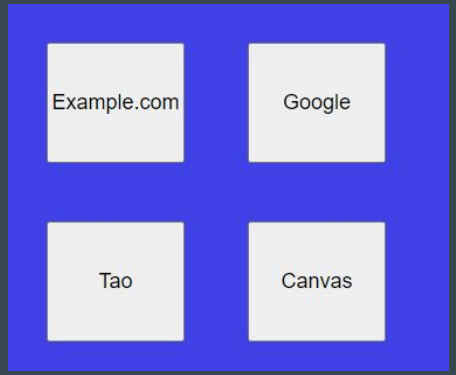
Two notable examples:

- Google Cardboard
- Project North Star



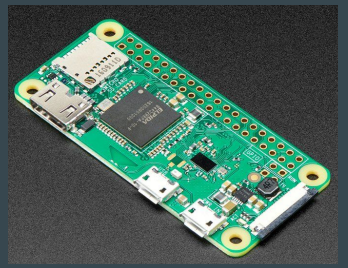
Requirements

- Functional
  - Connect to internet
  - Access test
  - Interact with test
  - Cannot access outside resources
- Non-functional
  - Comfort of headset
  - Speed of loading pages
  - Intuitiveness of user interface



Constraints

- Cost
  - Must cost under $1000 for prototype
- Time
  - Must be developed within a semester
- Weight
  - Must be under 400 grams
- Power
  - Must remain charged

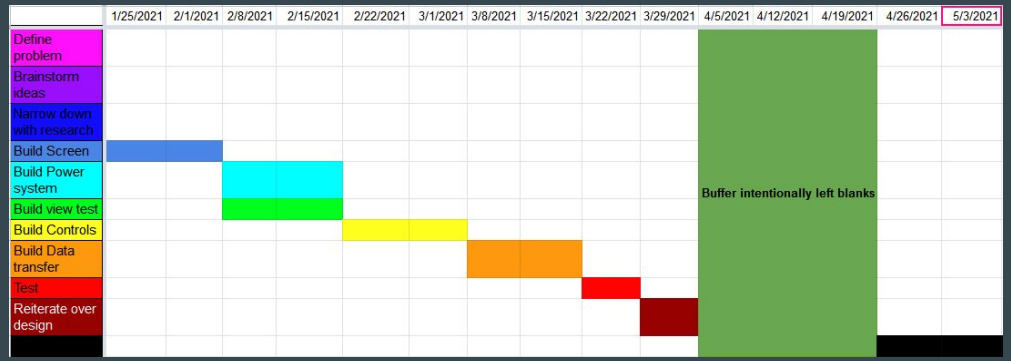


Standards

- Question and Test Interoperability (QTI)
  - IMS Global Learning Consortium
- Systems and software engineering -- Software life cycle processes
  - IEEE
- HTML Standard
  - WHATWG

Risks and Mitigation

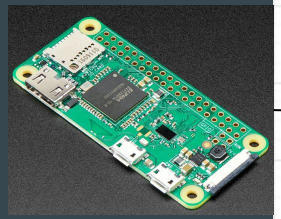
Scope too vast	Reduce features
Time overrun	Build buffer time into schedule
Cost overrun	Research alternative resources
Limited expertise	Contact ISU resources

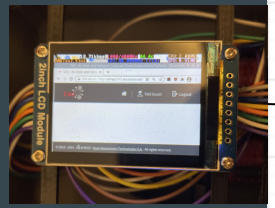


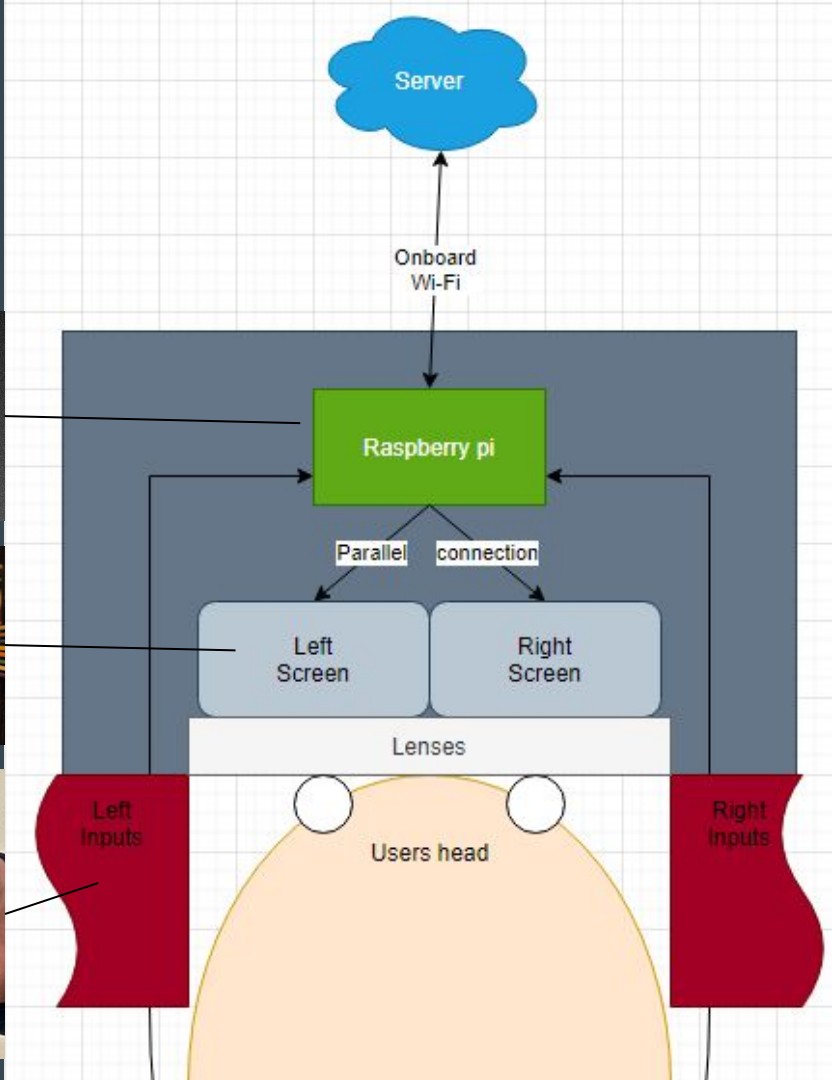
Hardware Design

Three main parts:

- Raspberry Pi Zero W
- Waveshare 2in 320x240 IPS LCD Screens
  - Connected via GPIO headers and SPI interface
- Input devices
  - Wireless trackball mouse
    - Mini-USB port
  - Touchpad
    - Mini-USB port







Headset Casing Design

Design Decisions:

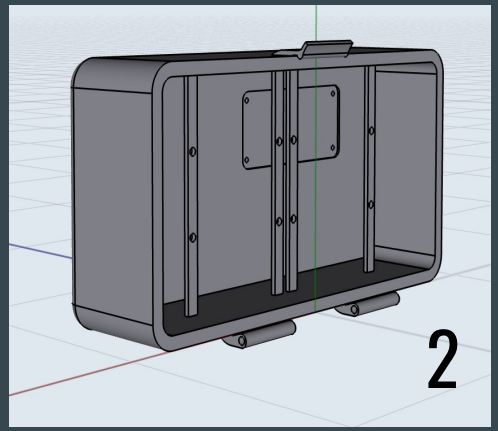
- Comfort and weight
- Software
- Redesign of headset casing designed by Rene Meeh of Arizona 360 VR

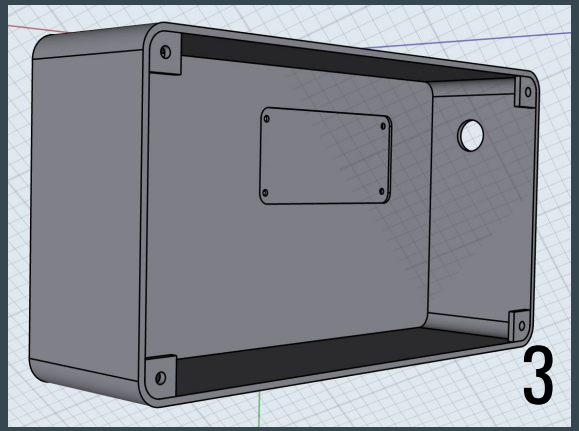
Iterations:

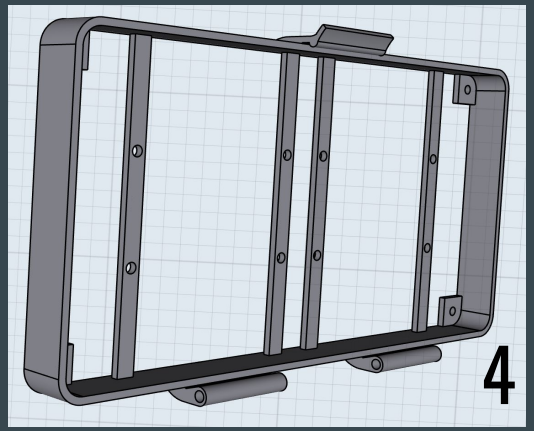
- 3 major iterations

Final Result:

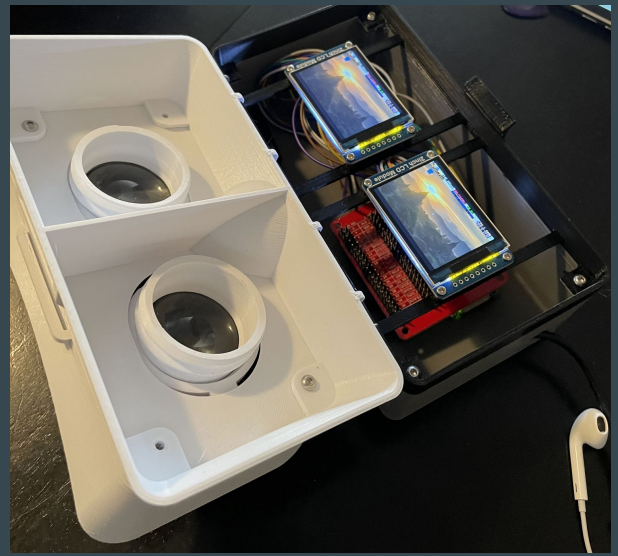
- 393.55 grams

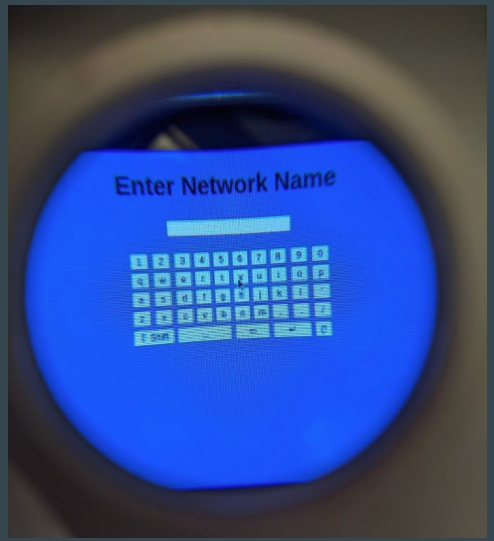






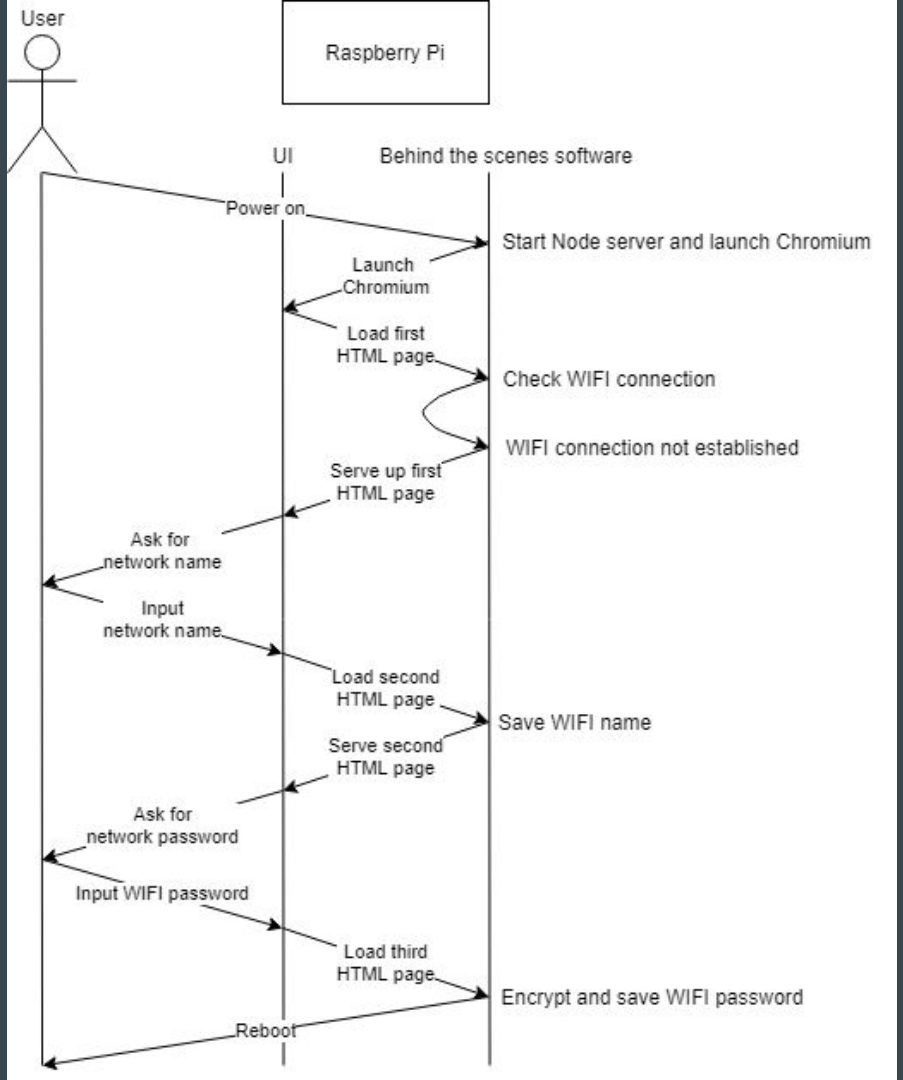
Hardware Demo





Software Design

- PI OS
- NodeJS
- Html and JavaScript
- Chromium in kiosk mode
- Tao server on Linux VM



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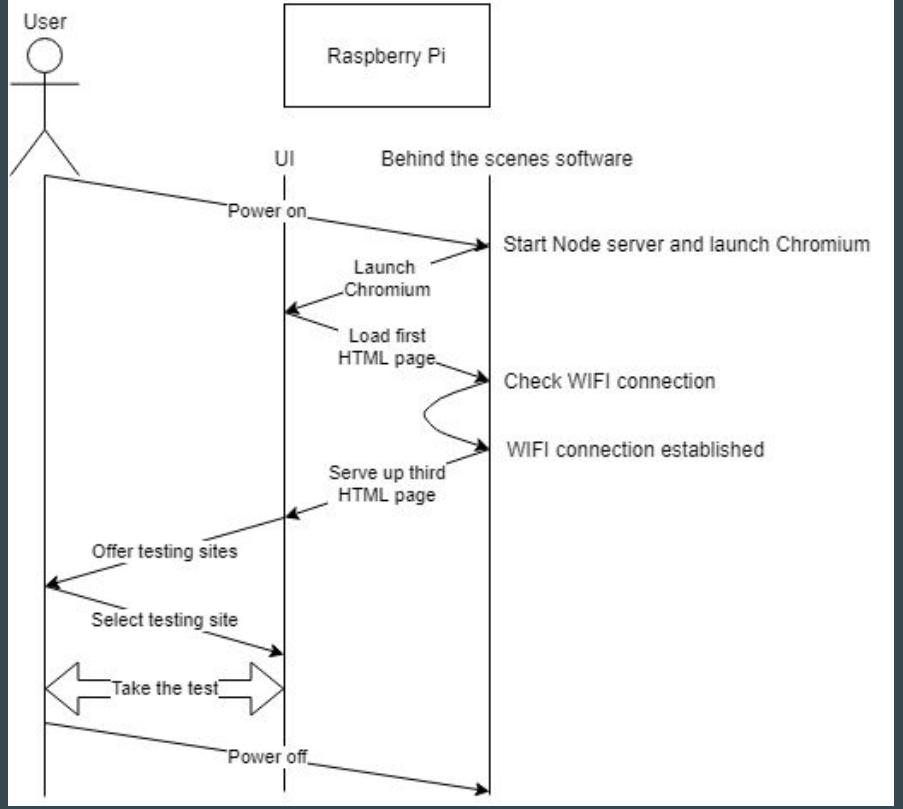
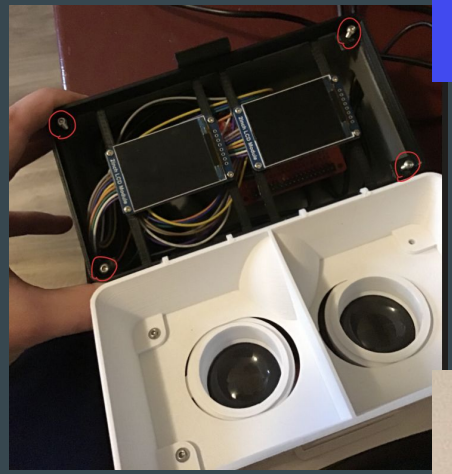


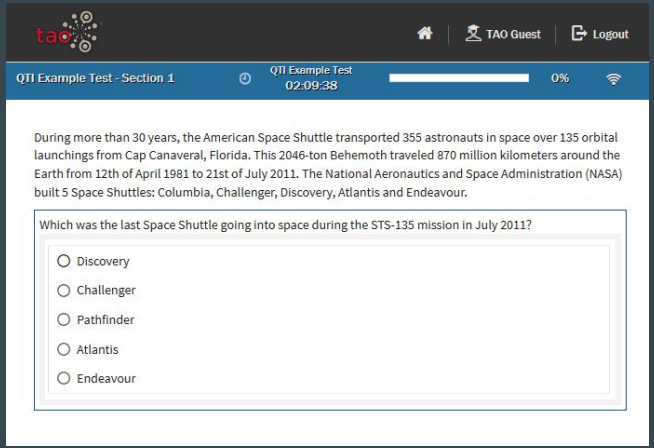
Development Testing

- Unit Testing
  - Tested individual software modules
  - Examples:
    - Opens Chromium in kiosk mode on boot
    - Stored network password is encrypted
    - Reboots after network configuration
- Interface Testing
  - Tested communication between modules
  - Examples:
    - Raspberry Pi to screens
    - Controls to Raspberry Pi
    - Raspberry Pi to Tao server



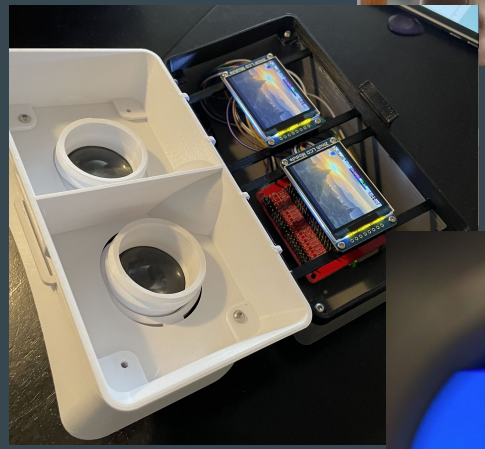
Acceptance Testing

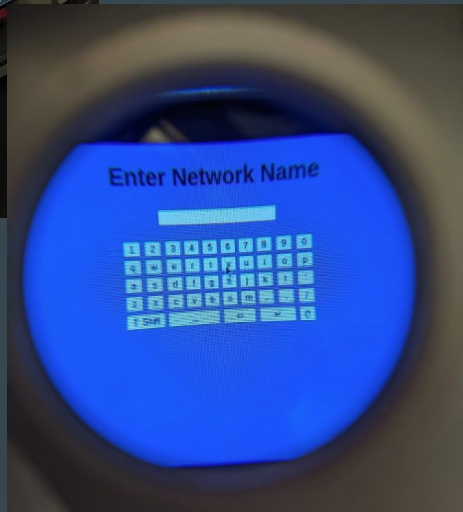
- User can connect to a nearby WiFi network
- User can access various URLs from the navigation screen
- User can log into Tao
- User can open and take a test from the headset after logging into Tao



Results

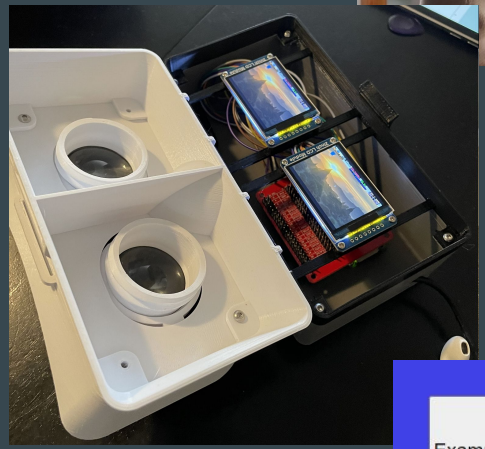
- Functional Prototype
- Simple Software Interface
  - Sign-in for network
  - Landing page to go off to testing platforms
  - User prevented from accessing anything else
- Reasonable Cost
  - Development cost: $191.05
  - Estimated production cost: $101.16
- Comfortable Weight
  - Final weight: 393.55g
  - Less than 400g constraint
- Limitations
  - Slow test data access due to insufficient on-chip memory

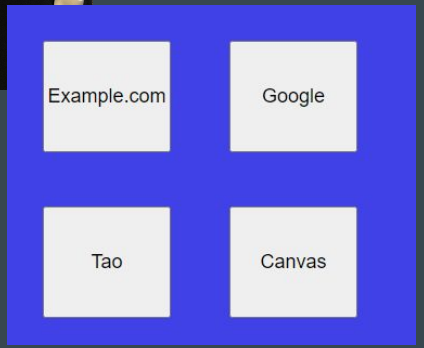




Conclusion & Future Work

- Challenges & Setbacks
  - Communication with client to understand vision
  - Initial scope of project was too broad
  - Prioritizing features
  - Virtual learning and work during pandemic
- Lessons Learned
  - Remote teamwork
  - More testing and iteration time
- Future Work
  - Sensors
  - Battery
  - Upgrade system components
    - Raspberry Pi
    - Case security





Thank You!

Questions?

Appendix: Cost

Item	Quantity	Unit Price	Total Price	Estimated Bulk Price (seems to be about 17 % off when in bulk)
Raspberry Pi Zero W	1	$37.30	$37.3	$26.11
Raspberry Pi Zero W	1	$36.30	$36.3	N/A*[1]
LCD Screen	2	$10.95	$21.9	$15.33
Jumper Cables	1	$1.95	$1.95	~~$1.37~~
Triple GPIO Expansion Board	1	$7.95	$7.95	$5.57
Lenses	2	$21.99	$43.98	$1.80*[2]
Foam for Casing	1	$12.67	$12.67	$8.87
Headset Strap	1	$8.00	$8	$5.60
Touchpad	1	$21.00	$21	$14.70*[3]
Wireless Handheld	1	$30.35	$30.35	$21.25*[3]
3d Print/Casing	1	$46.20	$46.2	$21.00
Hardware & Tools	1	$15.00	$15	minimal*[4]
Power Switch	1	$3.11	$3.11	$2.18
Shipping	1	$37.89	$37.89	
		Total Expenses:	**$191.05**	**$101.16***[5]
			Development	Product Estimate