



Sensor Suit Proposal

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Use Case

Improve game interactivity by incorporating more sophisticated tactile feedback that supports *The Last Spartan* desktop game.

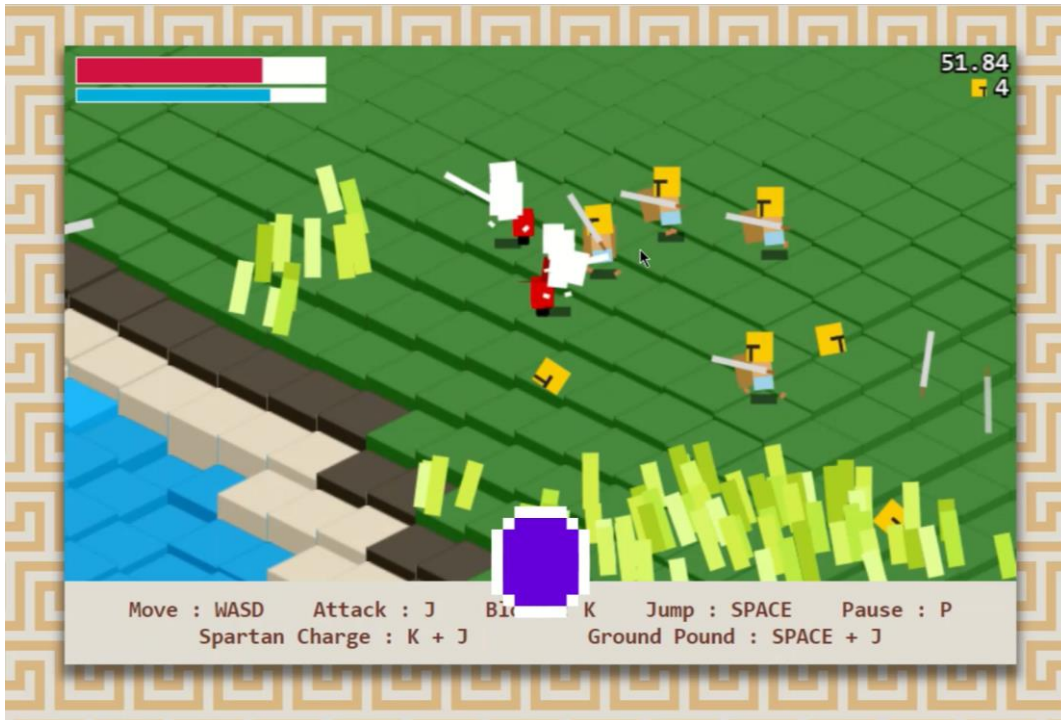
Areas covered: hardware, software systems, signals



Use Case Requirements

- Initialization of **haptic response** such that the feedback is indistinguishable from **actions on screen**
- **Feedback points** in front, back, and side of torso
- **4+ hours** of game time with the system
- Wearable system that is customizable to guarantee **comfort**

Design Concept

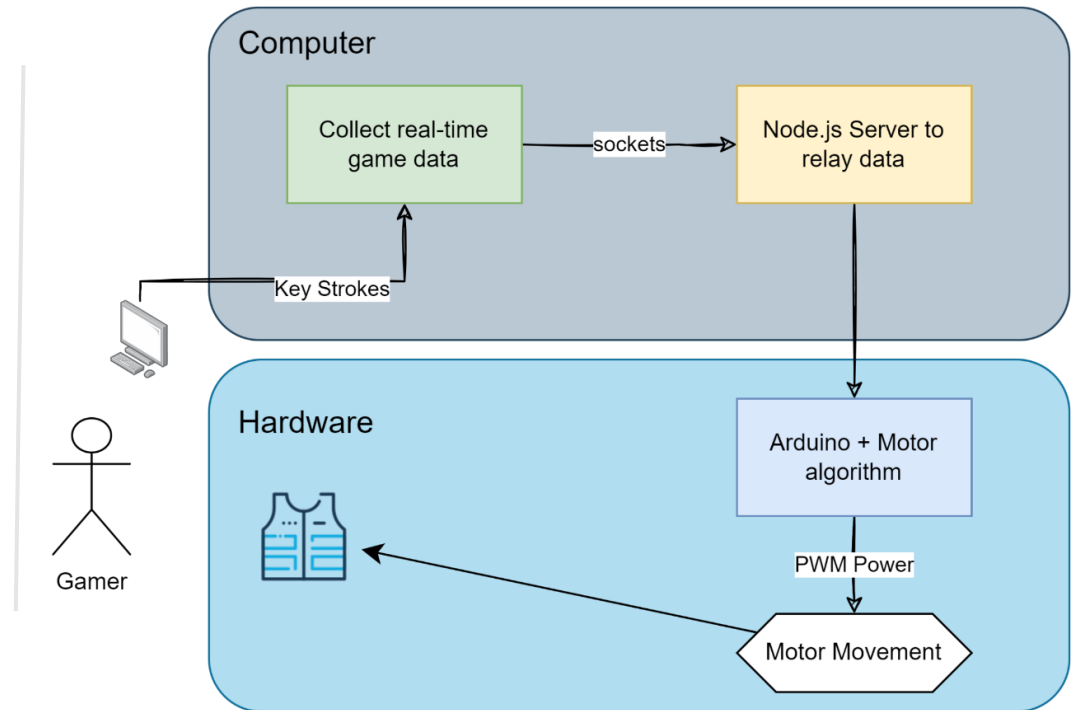


The Last Spartan



Solution Approach

- Collect real-time game data from the Javascript/html game code
- Build Node JS server to relay data
- Implement haptic response algorithm in Arduino IDE
- Use STM32 Nucleo Boards for haptic controls connections
- Secure 20 motors on vest (8 on front, 8 on back, 2 on each side) + RGB lights
- 30 ERM motors that run at 640 to 3200 RPM, creating 0.15 to 7 Newtons of force



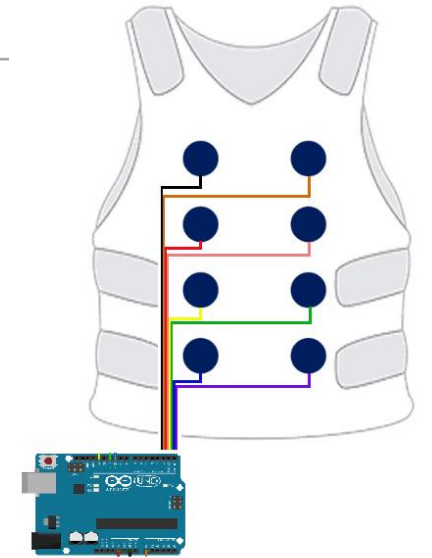
Technical Challenges (software)

1. Interpreting multiple in-game interactions that may occur simultaneously
2. Generating an algorithm that maps motor freq. to a unique haptic response for 4 different in-game events
3. Sending signals to haptic suit wirelessly within monitor refresh rate



Technical Challenges (hardware)

1. Securing + wiring the motors to the suit
2. Synchronizing the movement of the motors
3. Keeping system lightweight to maximize mobility
4. Receiving the signals to motors with minimal interference
5. Keeping with industry standards for the aesthetics of the suit
6. Figuring out where to package motors





Testing, Verification, and Metrics (software / hardware)

REQUIREMENTS

HOW TO MEASURE

GOAL

Modify existing game code

Count how many in-game actions can we interpret and send to Arduino

Send all relevant game data to Arduino

Motor synchronization

Record the time each motor turns on and off using Arduino

< 100 ms difference

Motor response

Ask user how intense the motor response was

.15N-7N of force

Motors are secured to vest

In the vest, record motor location before/after playing game

< 0.5" radially



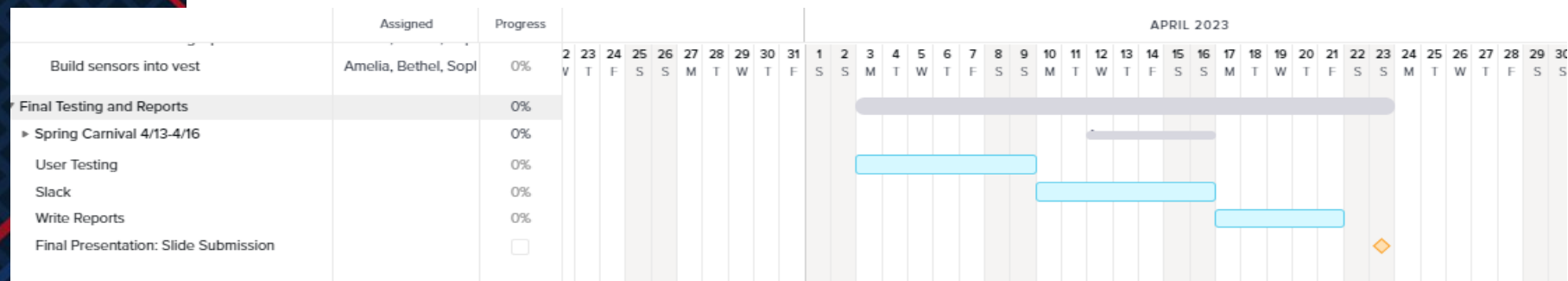
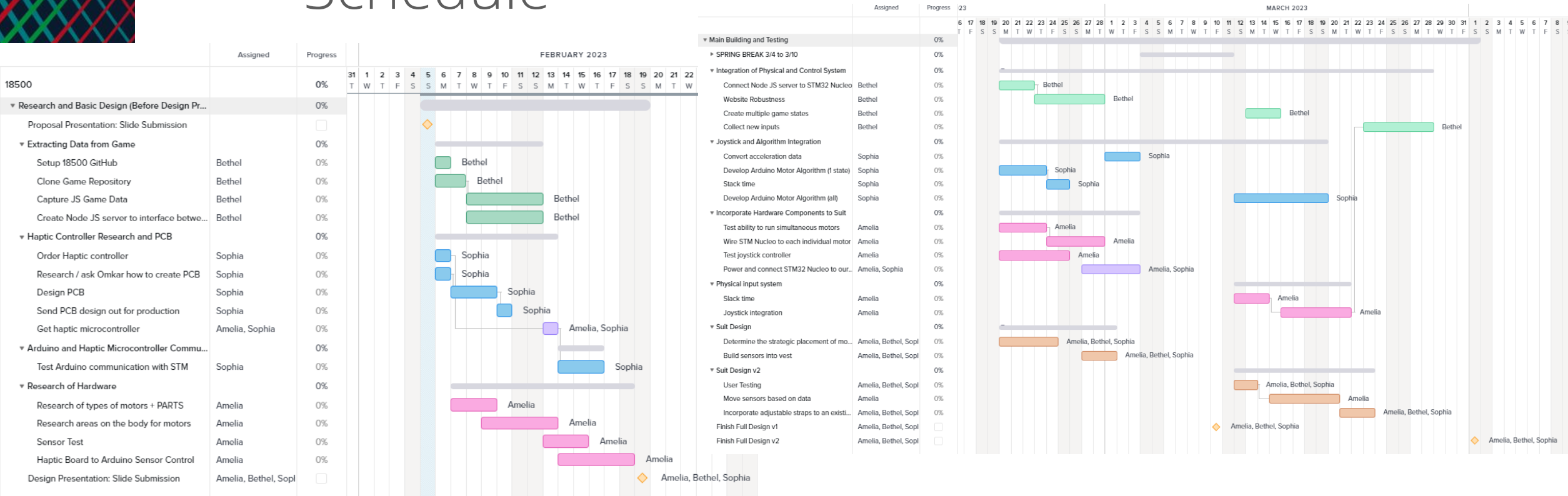
Testing, Verification, and Metrics (full system)

| REQUIREMENTS | HOW TO MEASURE | GOAL |
|--------------------------|---|--------------------|
| Haptic response | Does the vest respond uniquely to game action | 4 unique responses |
| Latency | Record time between game action and response | < 100 ms |
| Improved game experience | Survey feedback from users | Positive feedback |
| Cost | Sum cost from parts list | < \$150 |

Tasks and Division of Labor

| Tasks | Amelia | Bethel | Sophia |
|--|--------|--------|--------|
| Game data capture / Create Fork | | X | |
| Node.js server to Arduino | | X | |
| Getting data from Node.js | | | X |
| Arduino Motor algorithm | | | X |
| Sensor Testing | X | | |
| Haptic board to Arduino sensor control | X | | |
| Suit design | X | X | X |
| Assembly: Integration of software and hardware | X | X | X |

Schedule





Conclusion: Summary

- Aim to build a haptic vest that uses vibrating motors and RGB lights to **simulate in-game actions**
- Provide a **cost-effective** solution which increases user immersion in *The Last Spartan*