Project Summary

What if humans could extend their arms like telescopes, move them like tentacles, or grip with superhuman strength? Machine Yearning explores the future of human enhancement through a wearable system of additional limbs, controlled by brain signals to transform how we interact with our world.

Overall Goals and Key Questions

Machine Yearning investigates a provocative question: how might voluntary bodily augmentation transform human experience when it's pursued not as a replacement, but as an enhancement? This research challenges traditional narratives around prosthetics and human capability by designing additional limbs for those who don't need them, deliberately blurring the line between enhancement and natural ability.

The project approaches this question through physical prototyping of brain-controlled additional limbs. Using EEG technology from New York City neurotechnology partners, combined with custom-fabricated mechanical systems, the project will demonstrate real-time neural control of supplementary arms. The choice of physical prototyping over conceptual or virtual design is deliberate - by creating tangible, functioning augmentations, the project moves beyond speculation into provocative demonstration of possible futures.

This work sits within the critical and speculative design tradition, questioning our assumptions about bodily optimization and human enhancement. Rather than solving a defined problem, it creates a platform for examining deeper questions: How might additional limbs transform our daily interactions? What happens to social customs and personal space when human bodies transcend their traditional forms? When does enhancement become transformation?

The technical implementation, while challenging, serves a larger purpose. The integration of neurotech, mechanical systems, and human adaptation creates a working prototype that pushes beyond theoretical discourse. By combining 3D printing, precision electronics, and neural interfaces, the project demonstrates not just what could be possible but invites critical dialogue about what should be possible.

Work Plan

Pre-Spring Preparation (November 2023 - January 20, 2024)

- Refine existing 6-finger prototype through iterative testing and mechanical optimization
- Document current servo motor control systems and establish baseline response times
- Research EEG signal processing methods, with focus on multi-channel neural control
- Detailed consultations with neurotech startup to understand hardware specifications and limitations
- Extensive design research including ergonomic studies and user interaction patterns
- Begin sourcing critical components: motors, control boards, structural materials

- Develop initial signal processing algorithms for neural interface
- Create detailed CAD models for next-generation mechanical systems

Phase 1: EEG Integration (January 21 - February 29)

- Install and configure EEG hardware system
- Calibrate neural signal processing for individual finger control
- Develop Arduino-based interface between EEG system and servo controllers
- Begin systematic testing protocol:
    - Single finger control trials
    - Accuracy measurement and response time documentation
    - Gradual progression to multi-finger coordination
    - Analysis of neural adaptation patterns
- Implement real-time visual feedback system for user control
- Regular documentation of learning curve and control precision
- Iterative refinement of control algorithms based on testing data
- Weekly progress reviews and system optimization

Phase 2: New Arm Development (March 1 - 31)

- Finalize mechanical design incorporating Phase 1 insights
- Create detailed fabrication timeline for all components
- Begin manufacturing process:
    - 3D print primary structural elements using school's facilities
    - Laser cut precision components for joint mechanisms
    - CNC machine any metal components needed for structural integrity
    - Fabricate custom PCBs for control systems
- Develop modular assembly system for easy maintenance
- Install and test all electronic components:
    - Motor systems
    - Sensor arrays
    - Control boards
    - Power distribution

- Initial movement calibration and mechanical testing
- Implement refined control systems based on prototype learning
- Regular safety checks and structural integrity testing

Phase 3: Testing and Refinement (April 1 - 30)

- Begin comprehensive testing protocol:
    - Basic movement and control accuracy
    - Complex motion sequences
    - Response time measurements
    - Extended use trials
- Document all performance metrics:
    - Control precision
    - User adaptation rate
    - System reliability
    - Power efficiency
- Fine-tune neural interface based on extended testing data
- Optimize mechanical systems for improved reliability
- Begin compilation of technical documentation
- Create initial presentation materials
- Regular system maintenance and calibration
- Safety protocol development and implementation

Phase 4: Final Documentation and Presentation (May 1 - 14)

- Complete detailed technical documentation:
    - Design evolution and rationale
    - Manufacturing processes
    - Control systems architecture
    - Performance data analysis
- Produce high-quality documentation:
    - Professional photography of final system
    - Video demonstrations of key capabilities

    - Technical drawings and specifications
    - User interaction documentation
- Prepare comprehensive presentation materials
- Set up exhibition space with consideration for:
    - Live demonstration requirements
    - Safety protocols
    - Visitor interaction opportunities
- Final system optimization and reliability testing
- Project presentation and live demonstration

Significance

Machine Yearning's significance lies at the intersection of technical innovation and societal provocation. By demonstrating real-time neural control of additional limbs, this project moves beyond theoretical speculation into tangible demonstration, challenging our assumptions about human enhancement and bodily autonomy.

The technical achievement - translating brain signals into precise control of multiple artificial limbs - advances our understanding of neural interfaces and human adaptation. However, the project's deeper significance emerges from the questions it raises: What defines optimal human capability? Why do we accept certain bodily enhancements while questioning others? When does augmentation become transformation?

While the project's immediate outcome is a functioning prototype, its broader impact lies in sparking dialogue about human enhancement. By designing augmentations for those who don't 'need' them, it challenges traditional narratives around prosthetics and ability. The work will be showcased at Parsons’ Senior Product Design capstone gallery, where interactive demonstrations will allow audiences to engage directly with these questions.

The project aims to resonate with multiple audiences: engaging the technical community with its neural interface implementation, inspiring designers with its speculative approach, and provoking general audiences to question their assumptions about human capability. Even those skeptical of enhancement can appreciate the fundamental wonder of controlling additional limbs with thought alone.

Through this work, I hope to demonstrate not just what's technically possible, but to create a platform for discussing what's socially desirable in human enhancement, contributing to broader discussions about the future of human capability and design's role in shaping it.

Budget Explanation

The requested funds are essential for developing Machine Yearning's brain-controlled augmented limb system. The budget is structured around two core components: primary equipment and supporting materials necessary for prototype development.

The largest allocation ($1,049) is for the OpenBCI EEG Hardware Starter Kit, which is fundamental to the project's neural control system. This specific hardware was chosen for its research-grade quality, open-source architecture, and proven reliability in brain-signal processing. While I am pursuing additional funding through the manufacturer's student research program, securing this core component is critical to the project's success.

The Bambu Lab A1 3D printer ($299) represents a strategic investment in rapid prototyping capabilities. While the school has 3D printing facilities, dedicated equipment will allow for continuous iteration and testing, essential for developing complex mechanical components. The printer's high precision and reliability make it ideal for creating detailed mechanical parts.

The remaining budget ($1,312) is carefully allocated across materials and components necessary for multiple prototype iterations:

- Various filament types ($335) for different mechanical properties: PLA+ for structural components, PETG for durability, and TPU for flexible elements
- Electronics and control systems ($525) including servo motors, microcontrollers, and sensors for precise motion control and feedback
- Hardware and power systems ($245) ensuring reliable operation and safety
- Prototyping supplies ($85) for testing and development

Each component has been selected based on specific technical requirements and priced through market research. The budget maintains a small buffer for unexpected needs while focusing on essential elements that cannot be sourced through existing school resources.