# Provisional Patent Application

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## Title:

Closed-Loop Entropy-Responsive Biofeedback System for Biological Aging Modulation

## I. Technical Field

This invention relates to biotechnology, aging science, and medical device systems. Specifically, it describes a closed-loop biofeedback system that detects entropy-related biological signals and delivers adaptive therapeutic interventions to slow or reverse age-related dysfunction.

## II. Background

Biological aging is increasingly recognized as a systemic loss of structural, energetic, and informational order—akin to a thermodynamic increase in entropy. Current therapeutic approaches do not dynamically account for entropy metrics in real time. The proposed system fills this gap by creating an autonomous, feedback-driven interface that can measure, interpret, and act upon real-time entropy signals in a biological system.

## III. Summary of Invention

The invention comprises a system for monitoring biological entropy and delivering precision therapeutic interventions based on adaptive algorithms. The key components include:

1. Entropy Biomarkers and Sensors:  
 - HRV entropy, NAD⁺ levels, ROS, mitochondrial membrane potential (ΔΨm), neural signal coherence, transcriptomic entropy

2. AI-Driven Controller:  
 - Monitors entropy inputs  
 - Determines optimal timing/type/dose  
 - Updates its algorithm adaptively

3. Therapeutic Intervention Modules:  
 - Photobiomodulation (660–850 nm)  
 - Pulsed EMF (8–30 Hz)  
 - Thermal cycling, CR mimetics  
 - Auditory/cognitive entrainment signals

4. Integration Platform:  
 - Wearable, implantable, or external system  
 - User interface and cloud support

## IV. Key Claims (Preliminary)

1. Closed-loop system adjusting therapeutic output based on entropy-related biomarkers.  
2. Use of entropy metrics to guide interventions.  
3. Adaptive control algorithms to modulate biological aging.  
4. Modular therapeutic outputs targeting entropy reduction.  
5. Multimodal entropy biosensors.

## V. Exemplary Use Case

A subject wears a patch or implantable device that monitors HRV and NAD⁺. When entropy exceeds a threshold, it triggers EM pulses and NIR light. The AI evaluates the response and adapts future interventions.

## VI. Advantages

- Real-time adaptive therapy  
- Multimodal entropy sensing/response  
- Personalized aging modulation  
- Integration with wearables/implants

## VII. Drawings and Figures (To Be Added)

1. Block diagram  
2. UI example  
3. AI logic flow  
4. Output modules  
5. Entropy reduction chart

## VIII. Description of Variants

Wearable/implantable configs; multimodal sensors; various control algorithms; cloud or offline operation.

## IX. Future Extensions

Includes genomic entropy metrics, digital twin integration, neurodegeneration prevention.