PROVISIONAL PATENT APPLICATION

Inventor: Melanie Jeanette Grande

4209 Kibler Ln, Holiday, FL 34691

Independent Researcher

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TITLE

Adaptive Biofeedback System Using Entropy-Based Biomarker Detection for Aging Intervention

I. TECHNICAL FIELD

The present invention relates to the fields of biotechnology, aging science, and biomedical device engineering. Specifically, it describes a closed-loop biofeedback system that measures entropy-associated biomarkers in a biological subject and dynamically modulates therapeutic interventions to reduce entropy, thereby slowing or reversing age-associated biological dysfunction.

II. BACKGROUND

Aging is characterized by the progressive loss of biological order, resulting in increased cellular disorder, energetic inefficiency, and signaling noisephenomena analogous to a thermodynamic increase in entropy. Existing therapeutic modalities for aging lack real-time responsiveness and fail to adaptively engage with entropy-related physiological signals. A need exists for an integrated system that detects biological entropy states and applies targeted interventions to restore order and promote cellular homeostasis.

III. SUMMARY OF THE INVENTION

The invention discloses a closed-loop biofeedback system comprising:

1. Entropy Biomarker Sensor Module

- HRV entropy

- NAD+/NADH

- ROS

- Mitochondrial potential

- EEG coherence

- Transcriptomic entropy

2. Adaptive Control Algorithm (AI)

- Reinforcement learning / Bayesian optimization

3. Therapeutic Output Modules

- Photobiomodulation, PEMF, thermal cycling, CR mimetics, cognitive entrainment

4. Integration Platform

- Wearable/implantable/external device with UI and cloud integration

IV. EXEMPLARY USE CASE

A subject wears a patch embedded with biosensors that detect HRV entropy and NAD+ levels. When a threshold entropy value is exceeded, the system triggers photobiomodulation and PEMF. The AI evaluates biomarker response and adjusts future therapy parameters.

V. CLAIMS (PRELIMINARY)

1. A closed-loop system for modulating aging using:

- Entropy biomarkers

- Adaptive AI control

- Therapeutic delivery

- Feedback adjustment

2. Specific biomarkers include HRV entropy, NAD+/NADH, ROS, mitochondrial membrane potential

3. AI uses reinforcement learning

4. Therapies include light, PEMF, heat, drugs, cognitive entrainment

5. A method using steps a-e: detect, decide, apply, measure, adapt

VI. ADVANTAGES

- Real-time, adaptive therapy

- Integrates metabolic, electrical, and genetic signals

- Personalized interventions

- Scalable across platforms

VIII. DESCRIPTION OF VARIANTS

- Other entropy types (e.g., epigenetic)

- More therapies (e.g., ultrasound)

- Offline/cloud modes

- Integration with EHR or digital twin

IX. FUTURE EXTENSIONS

- Genomic entropy tracking

- Neurodegeneration prediction

- Digital twin modeling and entropy forecasting