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Novel Wearable System to Monitor, Predict, and Acutely Treat Epileptic Seizures

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CASE SCHOOL OF ENGINEERING
CASE WESTERN RESERVE UNIVERSITY

Presentation & Discussion Overview

I. Background

II. Design Goal & Semester Scope

III. Concept Overview & System Architecture

IV. Detailed Design

V. Summary

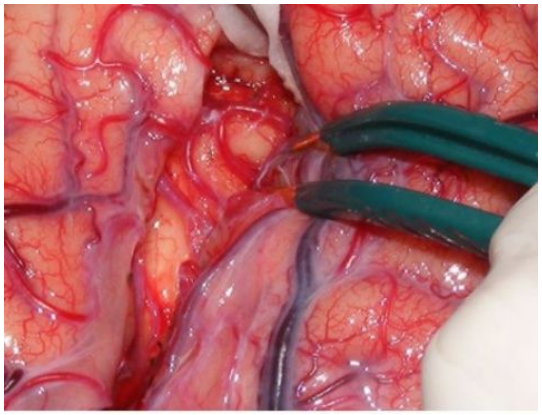
What is Epilepsy?[1]

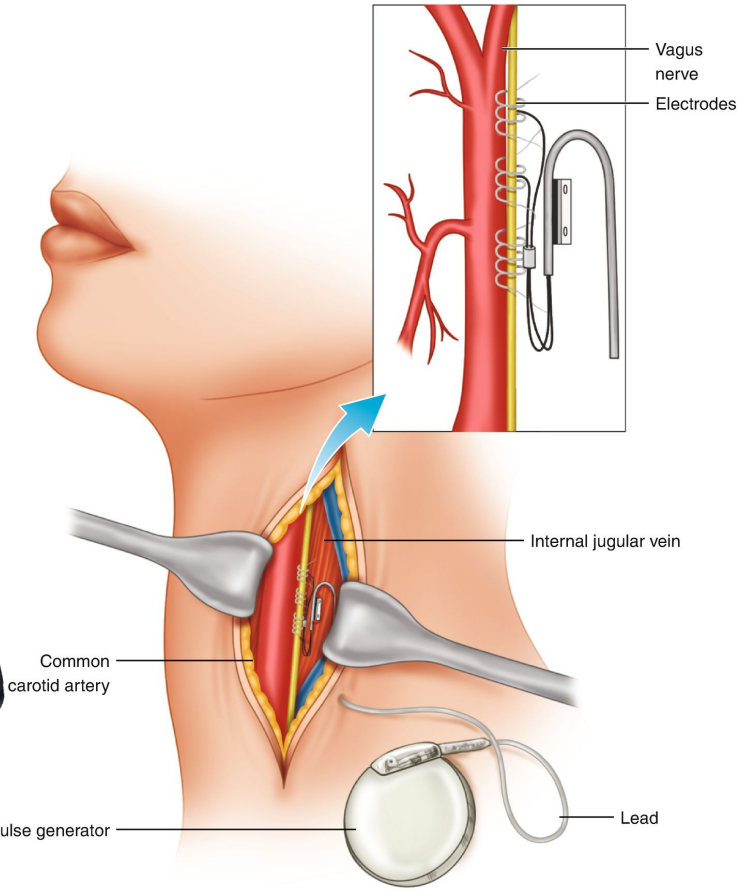
A chronic condition of recurrent unprovoked seizures characterized by **abnormal brain activity,** with seizure symptoms such as:

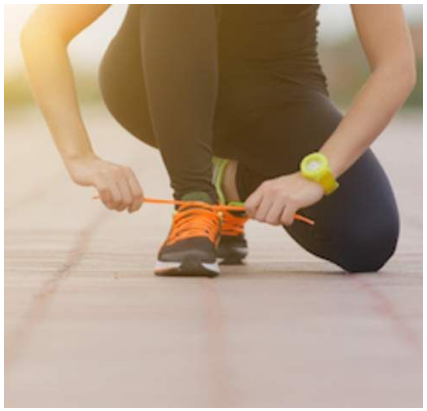
- impaired sensory input and loss of awareness
- muscle stiffening and jerking muscle movements
- loss of consciousness
- sudden unexpected death (SUDEP)

Focus: Generalized Tonic-Clonic Seizures (GTCS)

Managing Epilepsy: Current Therapies







Images from [2]-[7]

Need

A solution that alleviates the likelihood of serious complications by

predicting potential seizures

and

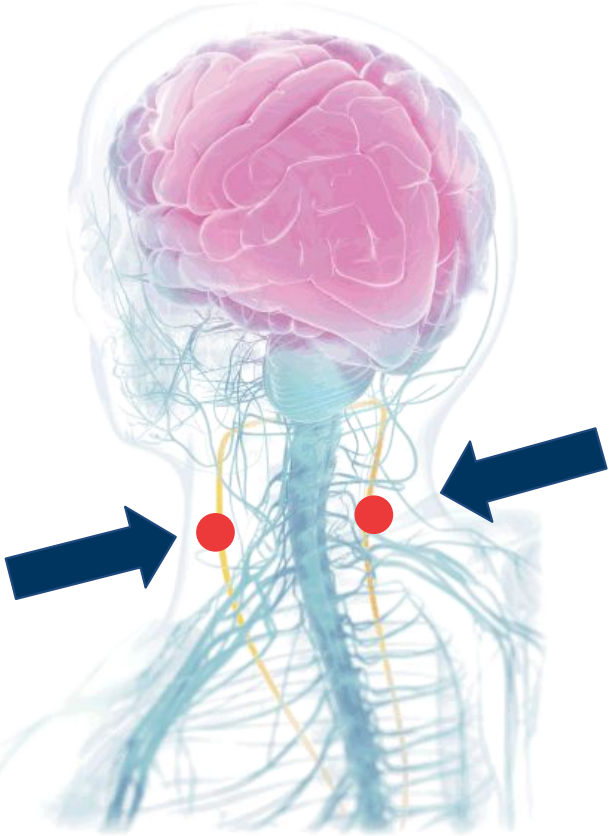
providing acute intervention non-invasively

Design Principle: Non-Invasive Vagus Nerve Stimulation (nVNS)

Transcutaneous Approach

Advantages

- Surgery not required
- Minimally painful
- Increased efficiency
- Greater compliance
- Feasibility[8]



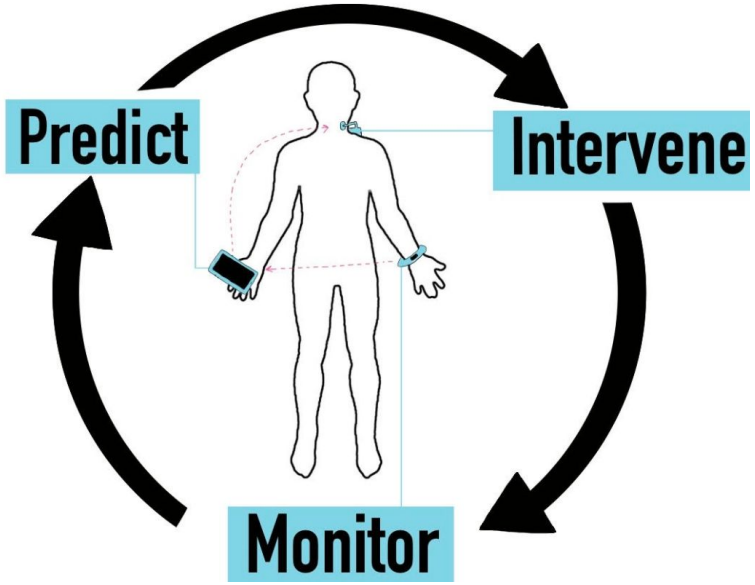
Current Amplitude: 0-40 mA
Target Frequency: 20 Hz

Image from [9]

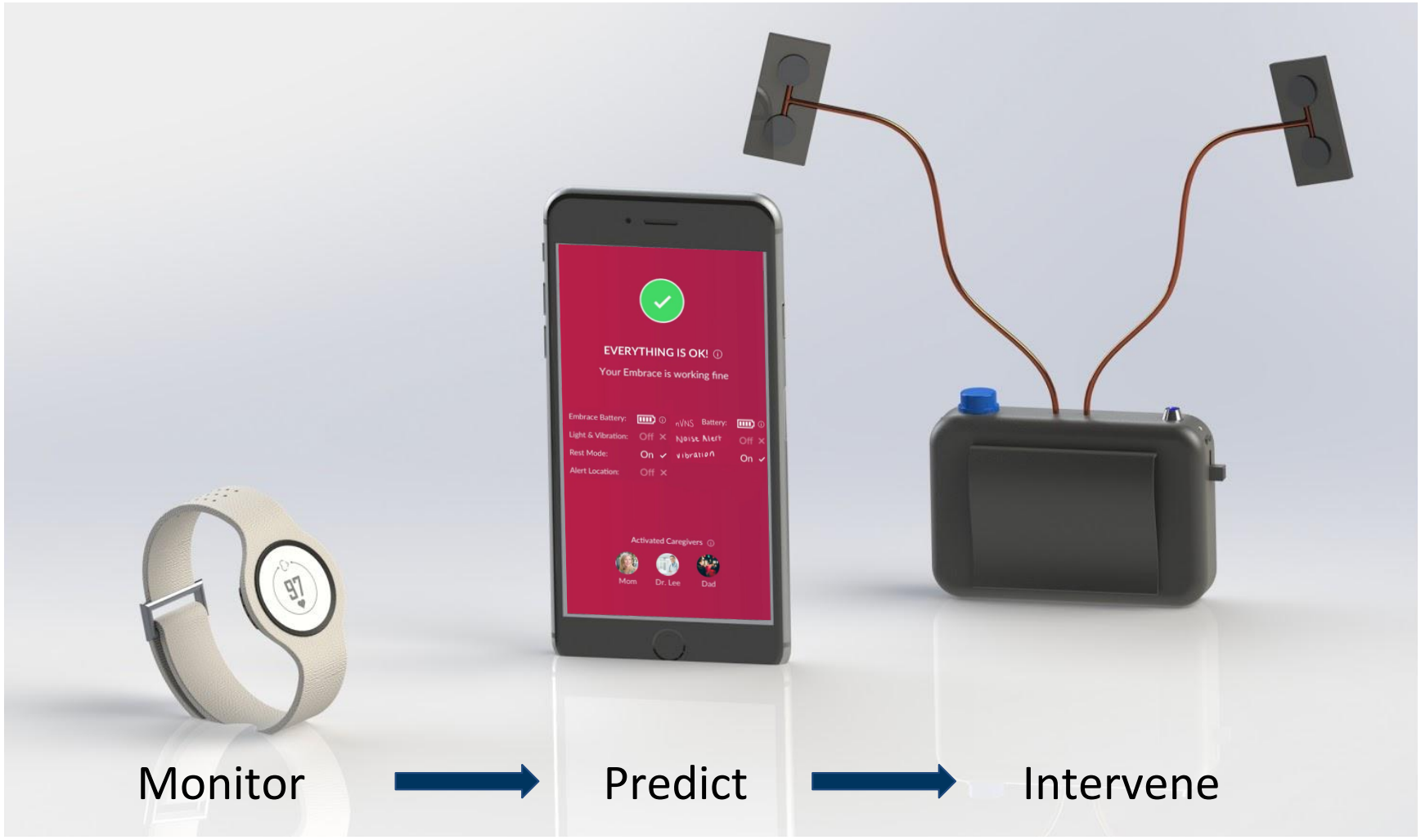
Design Goal

A system that

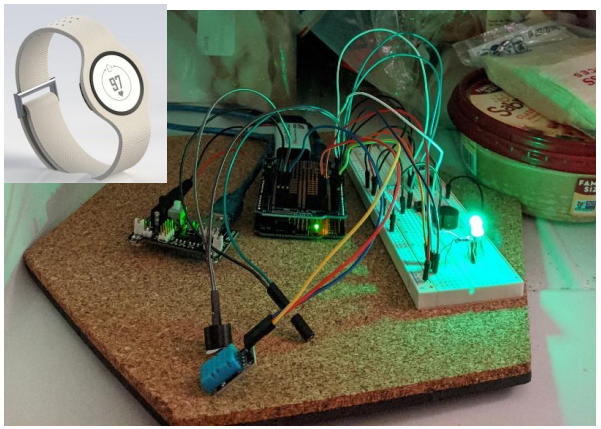
- continuously monitors physiological conditions
- predicts and notifies of potential seizures
- provides acute intervention non-invasively



Concept Design and Architecture



Alpha Prototype



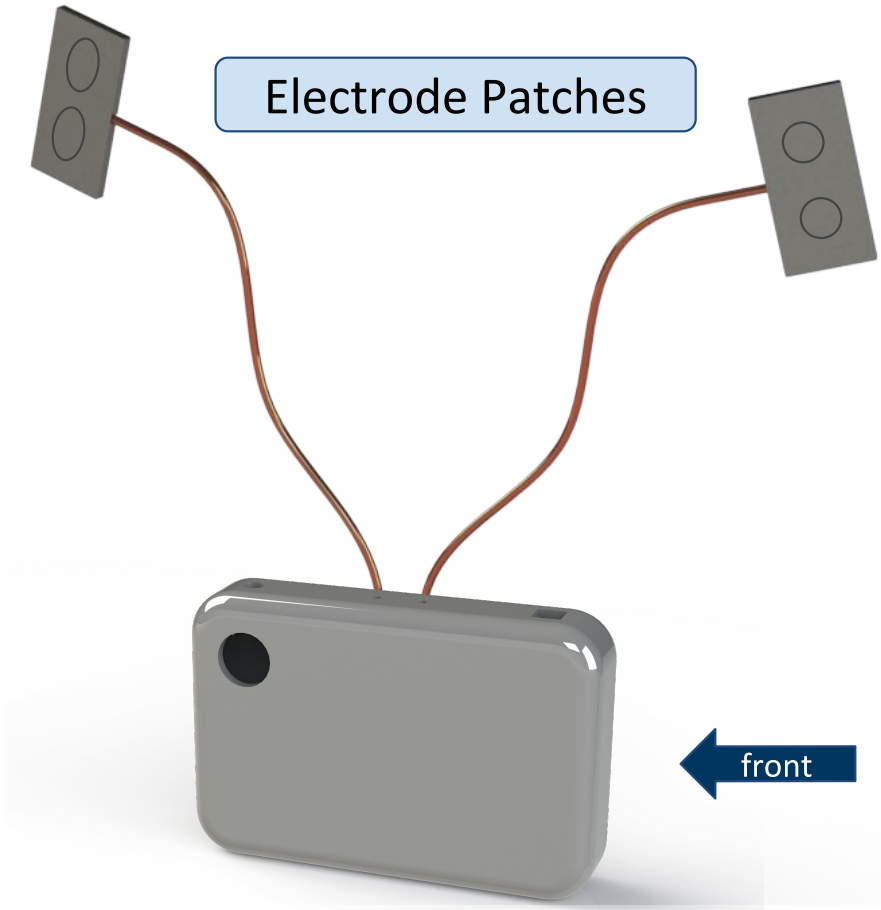
Monitor → Predict → Intervene

Design Goal: Beta Prototype

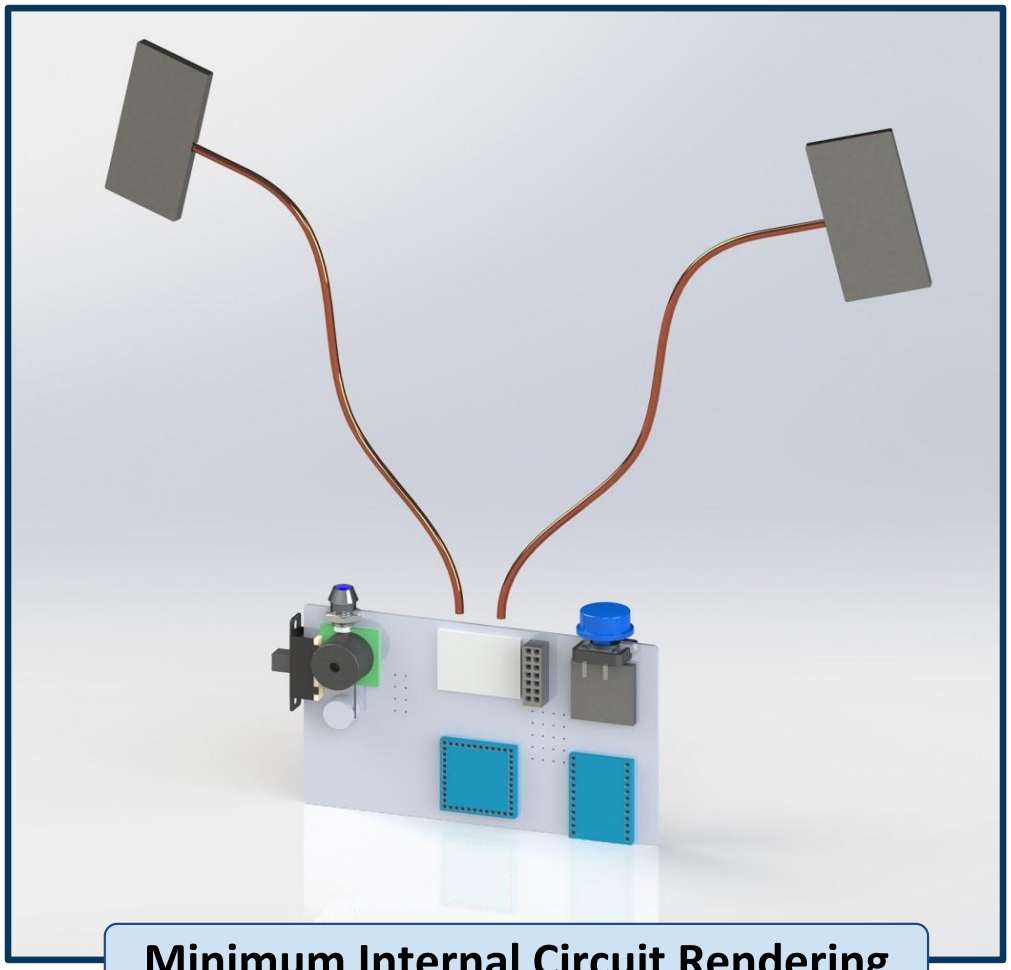
A system that

- continuously monitors physiological conditions
- predicts and notifies of potential seizures
- provides acute intervention non-invasively

nVNS Device Exterior Design: Beta Prototype

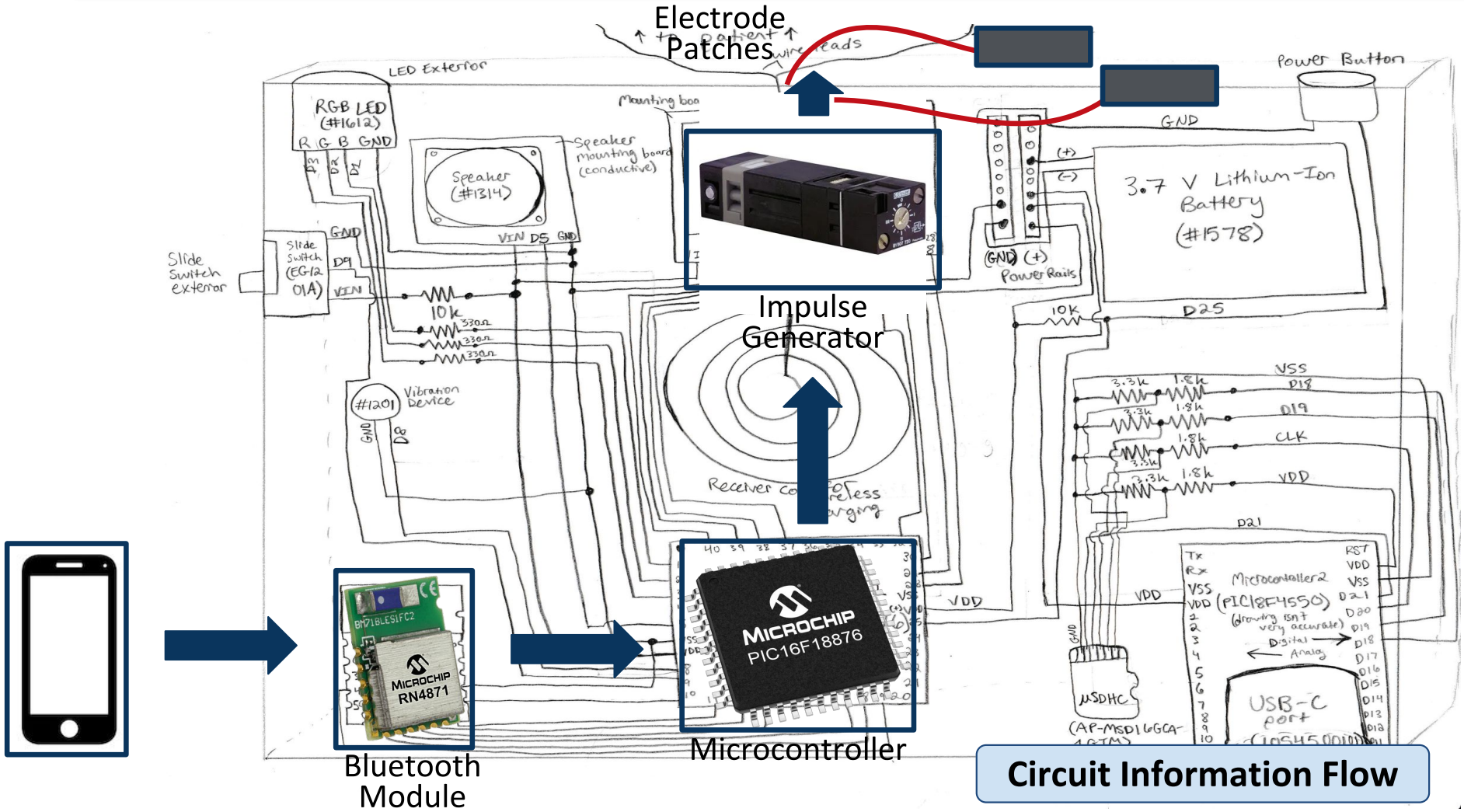


nVNS Device Interior Design: Beta Prototype

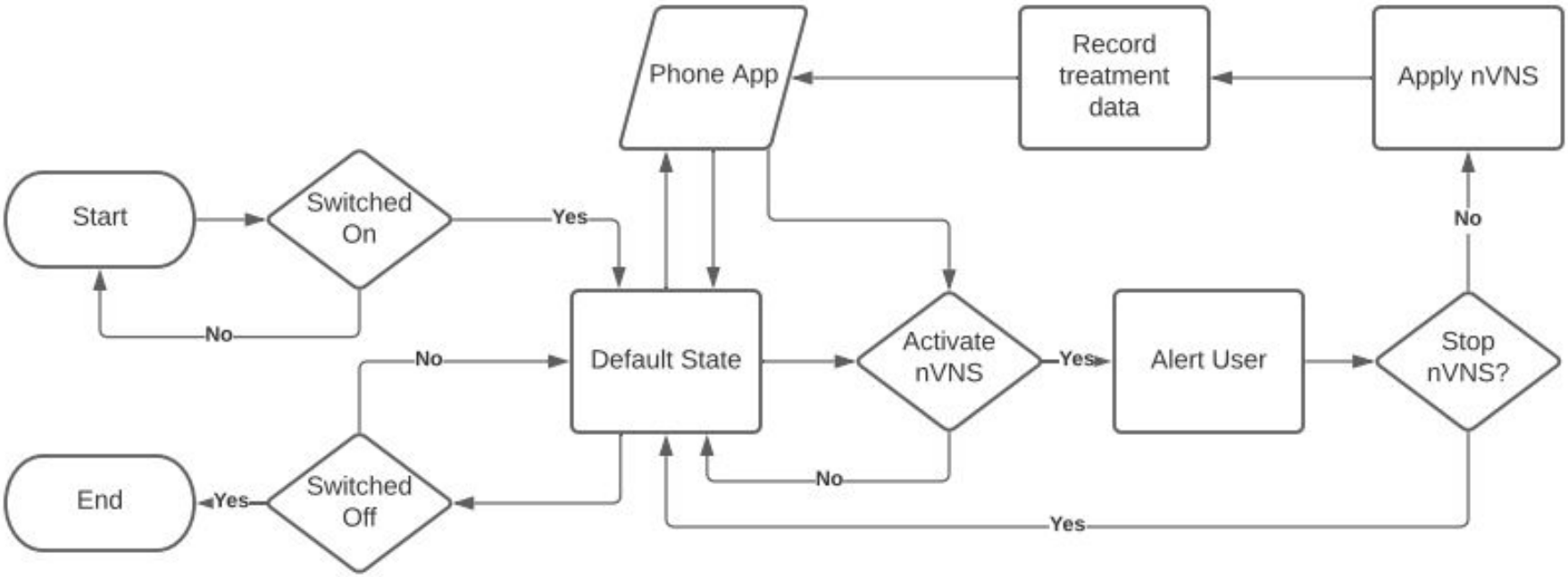


Minimum Internal Circuit Rendering

nVNS Device Interior Design: Beta Prototype



nVNS Software Logic Design: Beta Prototype



Summary: Prevalence[10]

50 million affected globally

Summary: Need

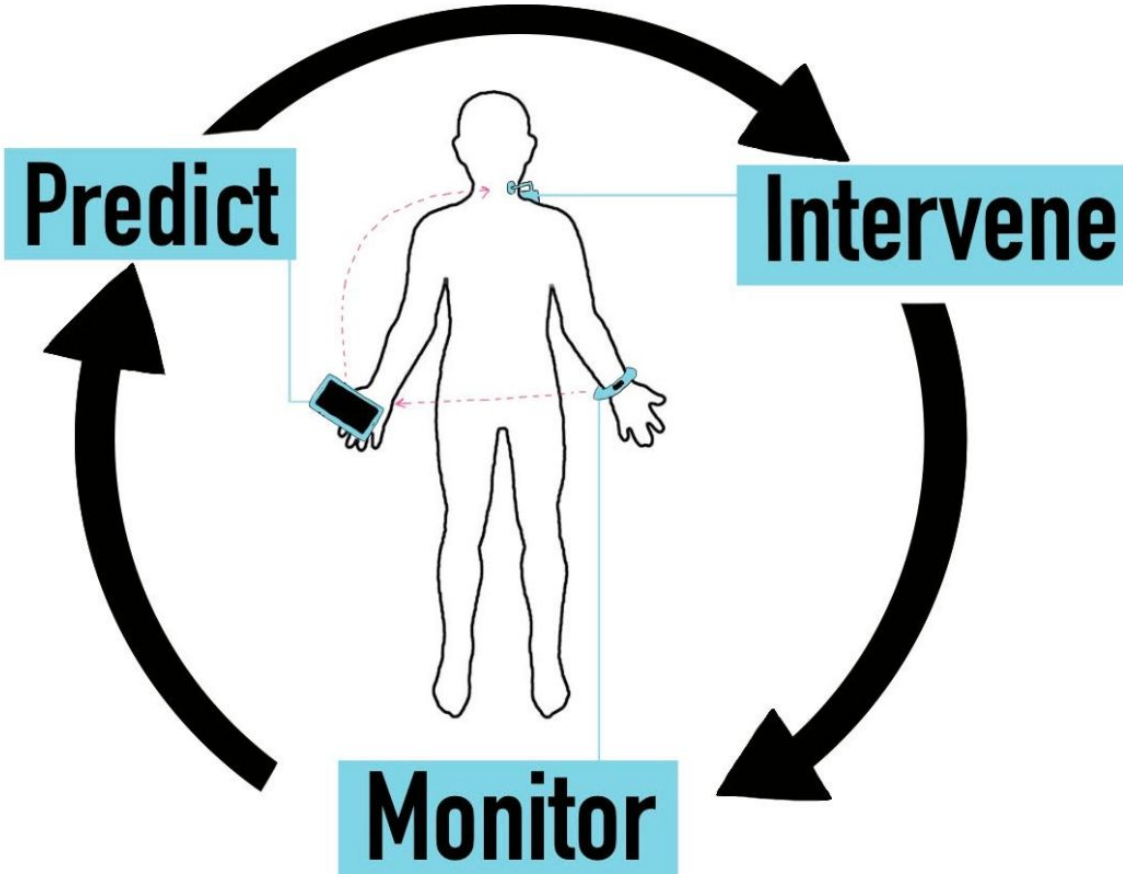
A solution that alleviates the likelihood of serious complications by

predicting potential seizures

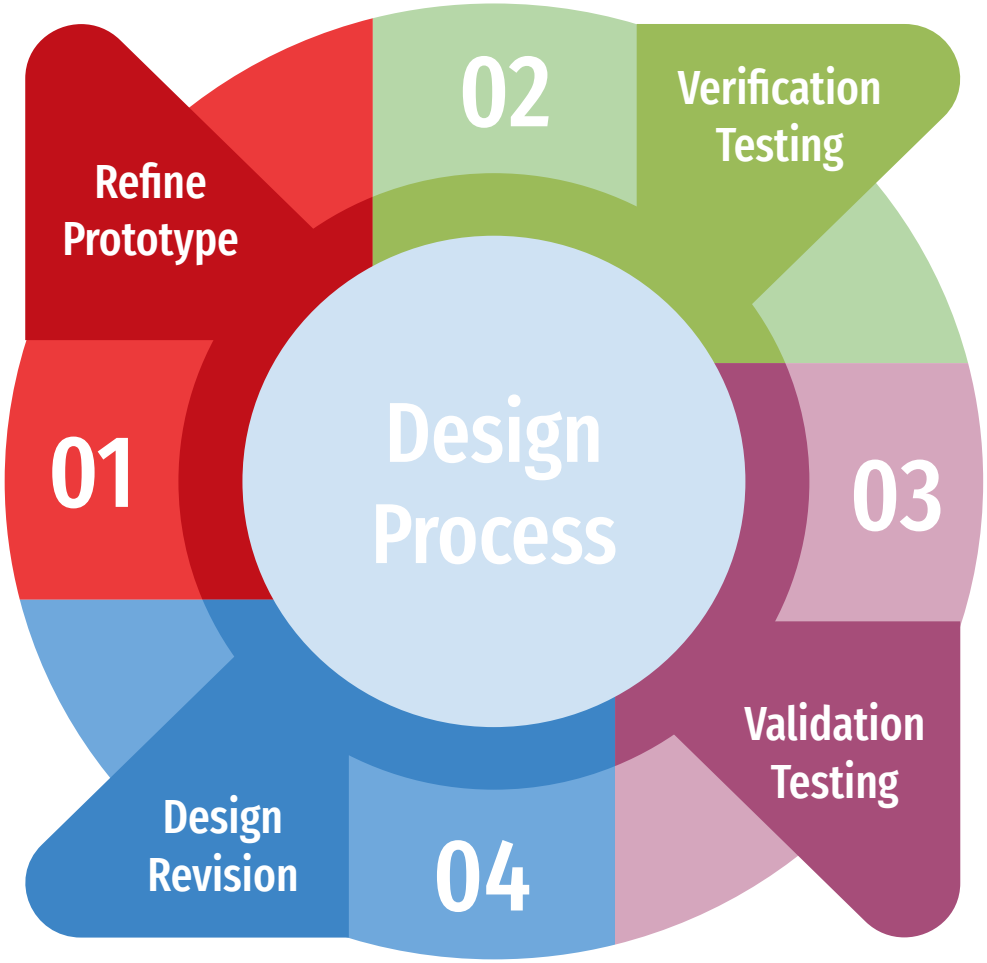
and

providing acute intervention non-invasively

Summary: Novel Solution



Summary: Path Moving Forward



Next Checkpoint

Semester End
Design Review &
Prototype Demonstration

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