SeizSmart

A mobile application for detecting, tracking, and reporting seizures in real time.

Feasibility Presentation

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Team Silver

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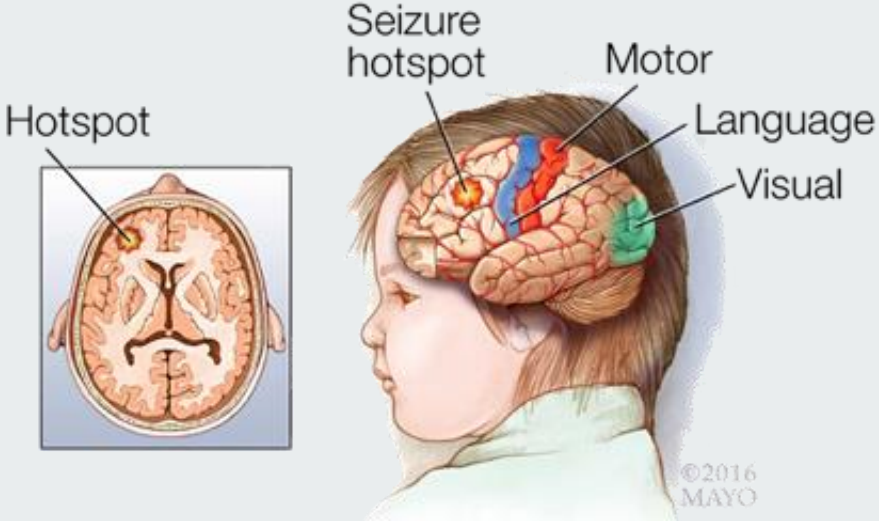

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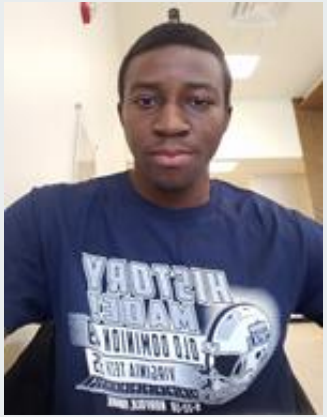

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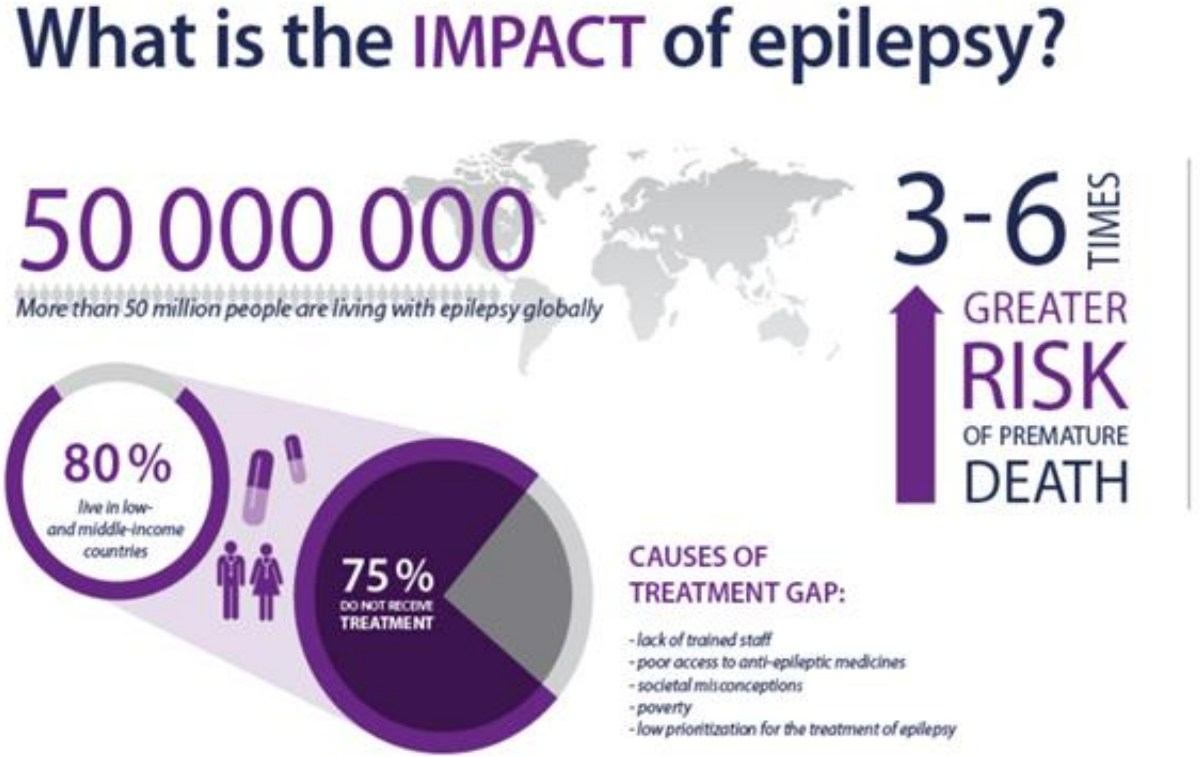
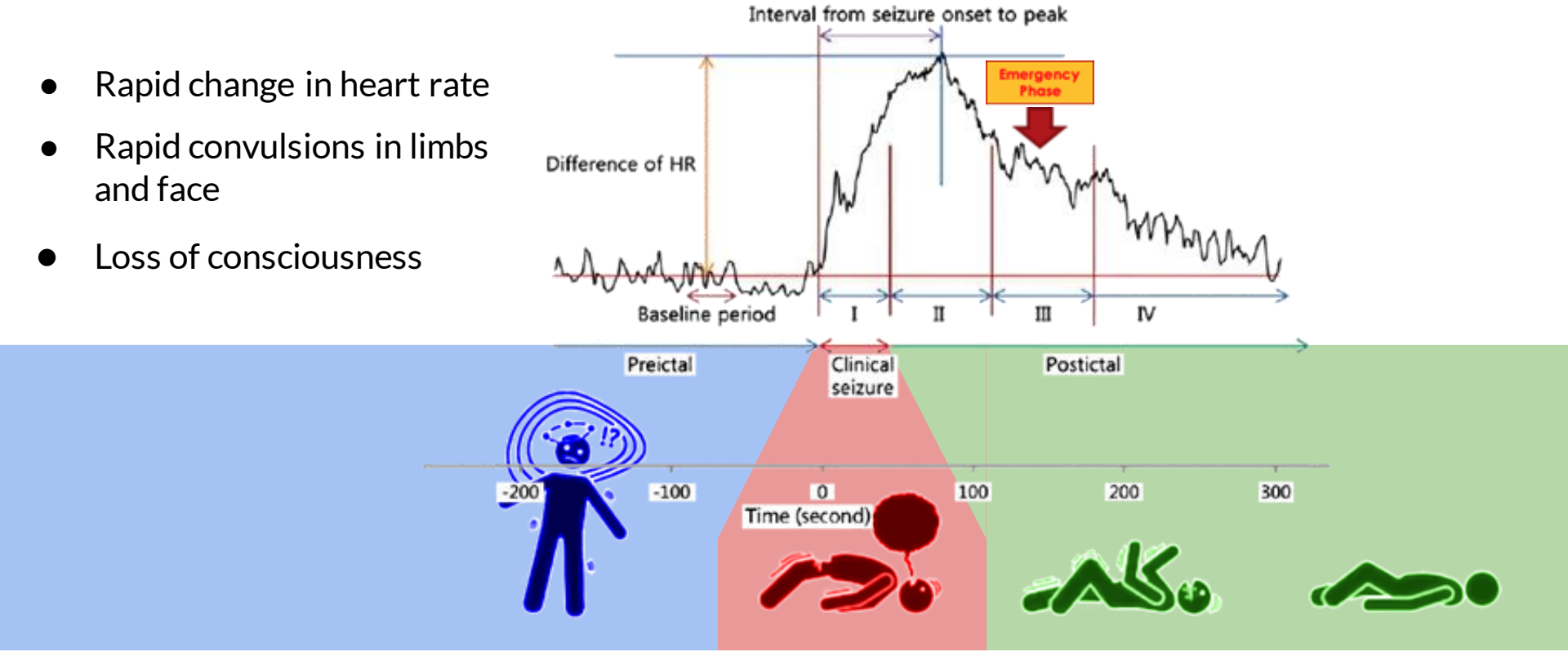
Background - Epilepsy

- Epilepsy is the 4th most common neurological disease in the world.
- Cases of epilepsy in the US have increased over the past five years.
- Cases in the US are predicted to increase further by 2020.



Characteristics of Generalized Seizures

- Rapid change in heart rate
- Rapid convulsions in limbs and face
- Loss of consciousness



Problem Statement

- Epileptic seizures are unpredictable and can result in injury or even death.
- Current technology does not provide the ability to automatically detect the onset of a seizure **based on a combination of heart rate behavior and repetitive body movements**.
- Available devices do not provide capabilities to tune detection variables to match individual patient seizure characteristics.
- Solutions that use smartwatch technology to detect seizures must be in the proximity of a smartphone to notify emergency contacts.

Who is Affected

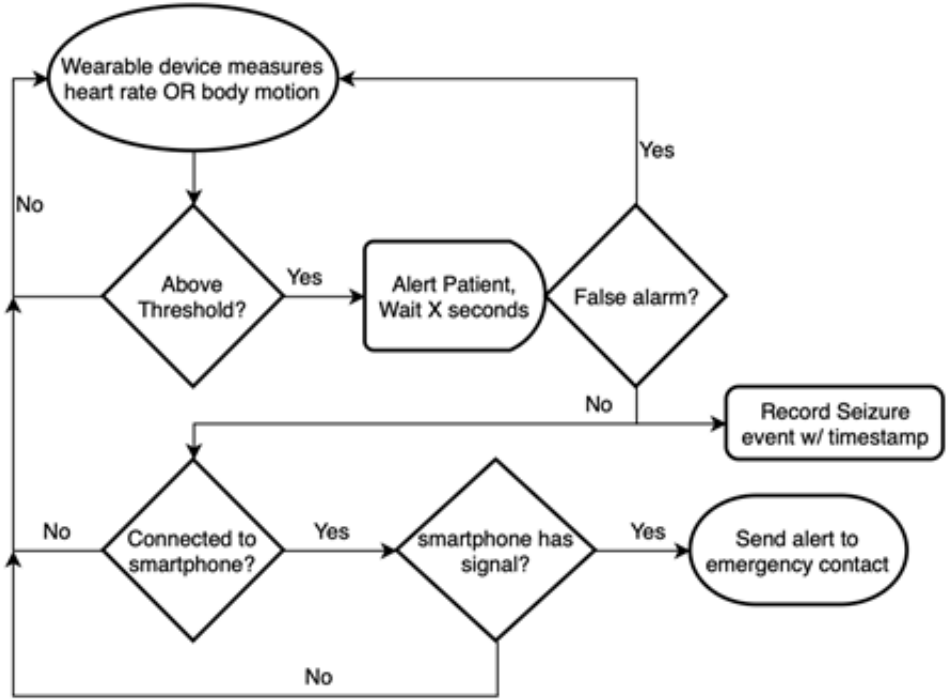
- Epilepsy can affect any age group from young children to seniors.
- About 25% of persons with epilepsy have generalized tonic-clonic seizures.
- It can also affect those who:
  - are Autistic,
  - have experienced a stroke,
  - or have suffered a significant infection or head trauma.

Problem Characteristics

- Existing technology relies on an increase in heart rate OR repetitive body movements (but not both) to detect the onset of a seizure.
- Concurrent recognition of a rapid change in heart rate and repetitive body movements is essential for improved accuracy and detection of seizures.
- Current solutions do not provide direct notification of emergency contacts from a wearable detection device.
    - They instead rely on a “relay” (such as a smartphone) which must be in proximity of the wearable to notify emergency contacts.
- Available solutions capable of detecting, tracking, and reporting seizures require either subscription services, prescriptions, or both.

Current Process Flow

- Most existing solutions detect seizures based on body motion.
- Some detect seizures based on users heart rate.
- The process flow for both are identical.
- No existing system detects based on a combination of both metrics.



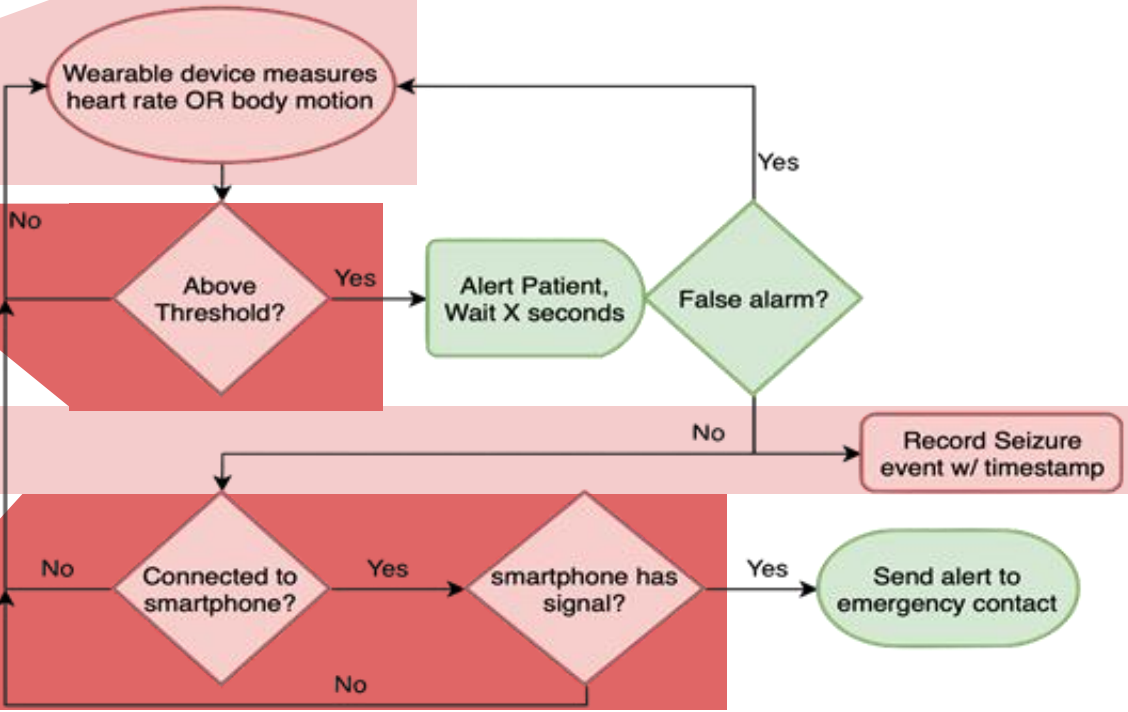
Current Process Flow

Wearables may access more data than HR/Motion.

Not all patients respond to seizures in the same way.

Current processes only begins recording seizure data after detection time.

Simpler notification capability is needed.



Solution Statement

Our proposed solution, SeizSmart, implements an advanced, wearable seizure detection capability using off-the-shelf smartwatch technology that is able to:

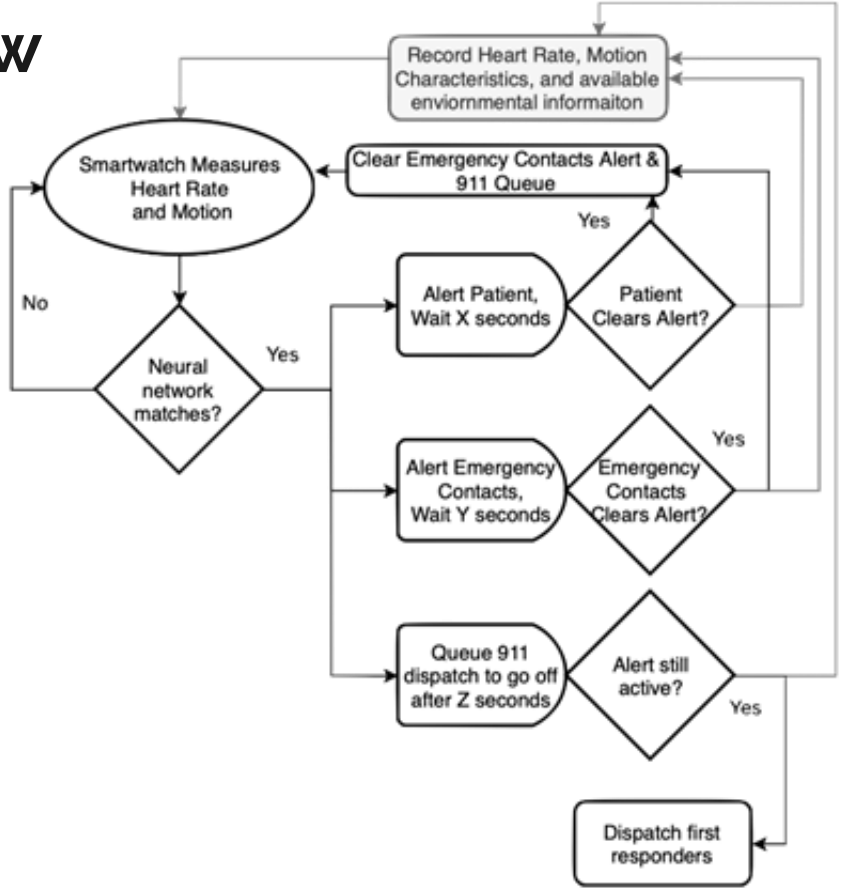
- automatically detect epileptic seizures using heart rate **and** motion metrics,
- tune a detection algorithm to match individual patient seizure characteristics,
- track and record all information surrounding seizure events,
- and provide automatic notification to emergency contacts without requiring a relay.

Solution Characteristics

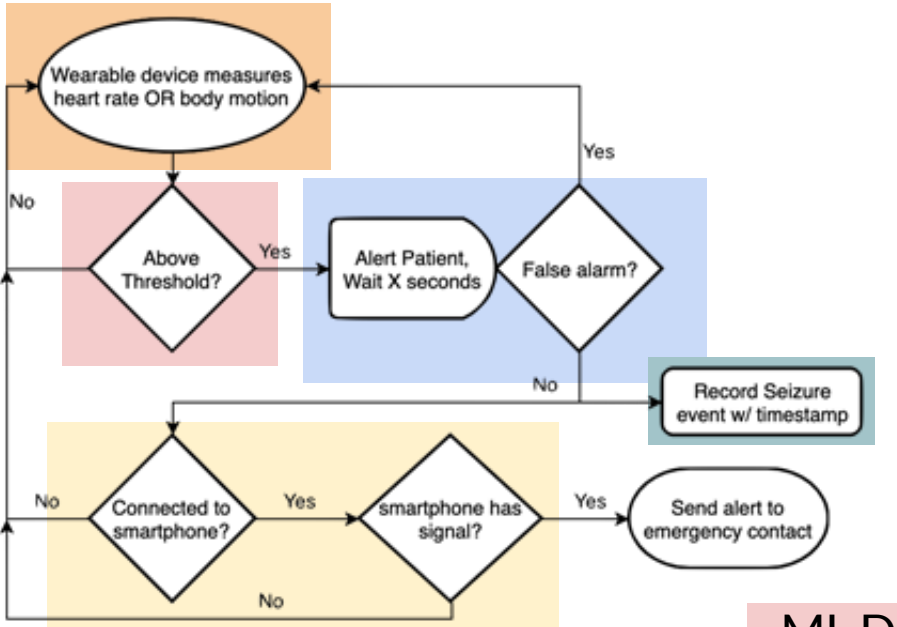
- Smartwatch technology is used for detection, tracking, and recording of generalized seizures.
- Machine learning technology is used to evaluate heart rate and body motion characteristics to establish a seizure profile for each patient.
- Heart rate performance and body motion are continuously monitored.
- Both heart rate and body motion information is used to indicate a detection.
- Available data about the environment during the onset of a seizure is collected.
- Automatic notification to emergency contacts or first responders is available when appropriate.

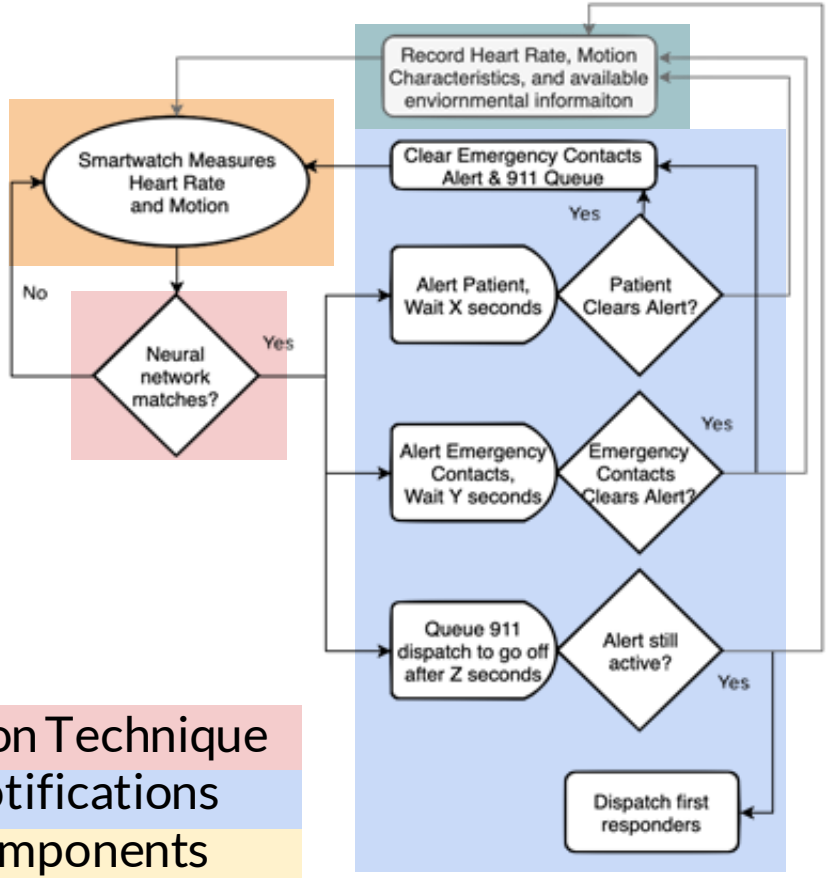
Solution Process Flow

- Detection is based on a combination of heart rate and body motion characteristics.
- Detection performance is enhanced using a trained machine learning approach.
- Emergency notification is issued directly from the user's smartwatch.



Process Flow Comparison





Measures >1 Data Point

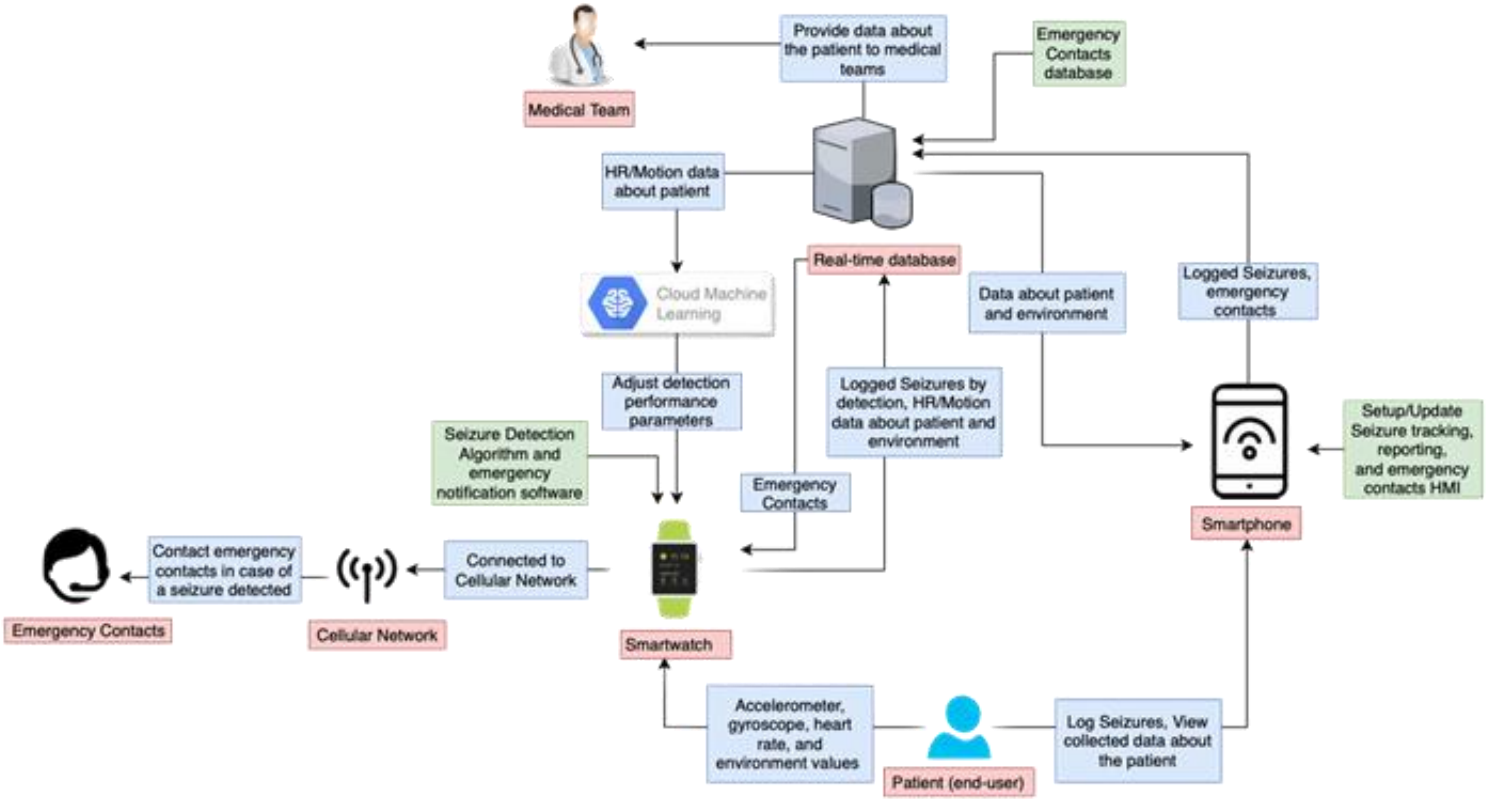
Records all event data

ML Detection Technique

Tiered Notifications

Fewer components

Major Functional Component Diagram



Competition Matrix

	SeizSmart	SmartMonitor	Direct empatica embrace 2	SeizAlarm	Indirect Epilepsy Journal	Epilepsy Health Storylines
Detect, record and track generalized seizures in real time	✓	✓	✓	✗	✗	✗
Monitor repetitive shaking motion	✓	✓	✓	✓	✗	✗
Continuously monitor the user's heart rate	✓	✗	✗	Only checks for elevated heart rate	✗	✗
Alert emergency contact when the user does not respond	✓	✓	✓	✓	✗	✗
Collect data about the environment at the onset of a seizure being detected	✓	✗	✗	✗	✗	✗
Function fully without dependence on a smartphone or external device	✓	✗	✗	✗	✗	✗
Use machine learning to detect generalized seizures	✓	✗	✓	✗	✗	✗
Require a subscription or prescription	✗	✓	✓	✗	✗	✗

Benefits to Customer Base

- Detection Performance and Hardware Flexibility
  - Each user's individual seizure profile provides more accurate and customized seizure detection.
  - The user may configure emergency response notifications as desired.
  - SeizSmart is compatible with both android and iOS smartwatch technology without the need for specialized hardware.
  - SeizSmart will be available without a subscription and a prescription will not be required.
- Peace of Mind
  - A smartphone does not need to be in close proximity to the smartwatch for detection and notification of emergency contacts.
  - SeizSmart is capable of notifying emergency personnel in extreme situations.

What SeizSmart Will Not Do

- It will not predict seizures
- It detects all types of generalized seizures except for absence seizures
- It is not a medical application and is not intended to be used in the diagnosis, monitoring, prevention, or treatment of epileptic seizures.

Key Points Summary

- SeizSmart is a mobile application based on smartwatch technology that is designed to improve the detection, tracking, and reporting of generalized seizures.
- The Problem
  - Current applications only check for an increase in heart rate or rapid body movements.
  - Current applications require a prescription or subscription plan in order to detect and track seizures.
  - Current applications require the smartwatch to be in close proximity to the relay device to transmit alerts and notifications.
- The Solution
  - Continuously monitor the end-user's heart rate and body movements.
  - Apply machine learning to the collected data about the end-user's seizures to build a unique, personalized, more accurate seizure profile.
  - Execute within the smartwatch itself to enable independent operation without requiring proximity to a relay device.

Who Benefits/Why Important/Why Feasible

- Who benefits?
  - Anyone who suffers from generalized seizures.
  - Medical/research teams looking for data about epilepsy.
- Why important?
  - Provides end-users with the ability to detect, track, and record seizures using a seizure profile uniquely crafted for them.
- Why feasible?
  - Seizmart leverages advancements in existing smartwatch and machine learning technology to detect seizures in real time.


Q&A

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