



SeizSmart

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

Feasibility Presentation Version 2.0

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Team Silver

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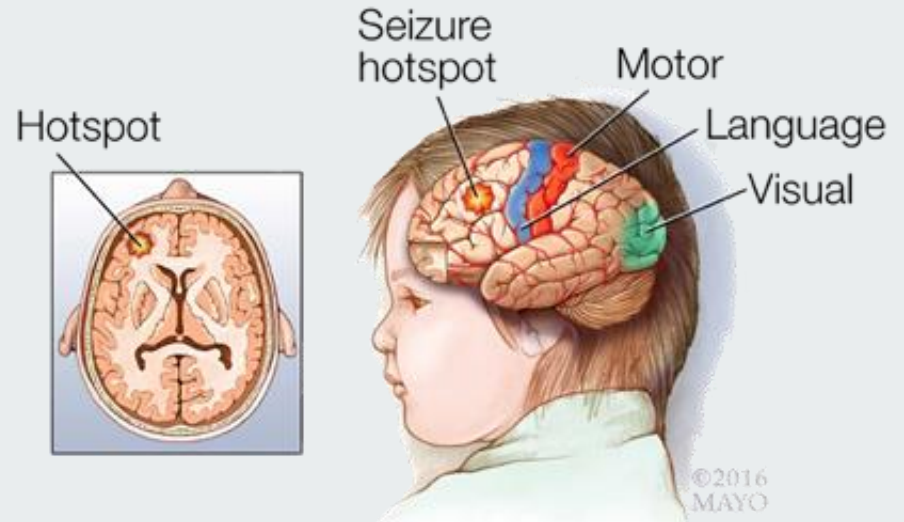




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The Team



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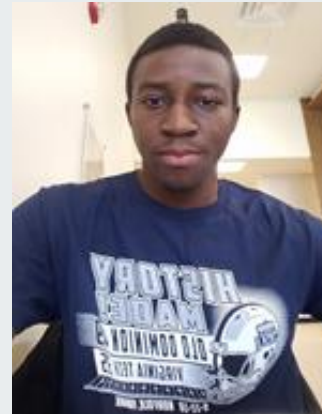
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UI/UX Developer - Smartwatch



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Background - Epilepsy

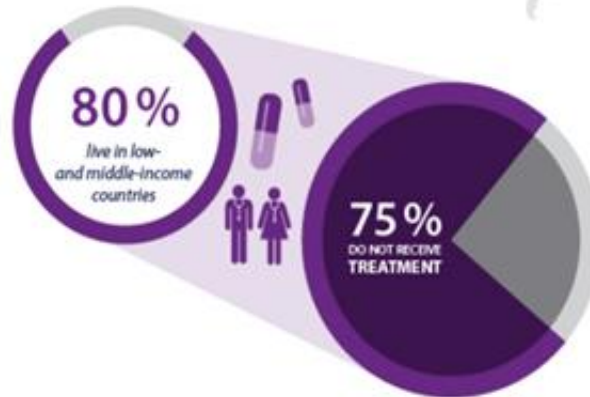
- Epilepsy is the 4th most common neurological disease in the world^[12].
- Cases of epilepsy in the US have increased over the past five years^[18].
- Cases in the US are predicted to increase further by 2020^[18].

What is the **IMPACT** of epilepsy?

50 000 000

More than 50 million people are living with epilepsy globally

3-6 TIMES
↑
GREATER
RISK
OF PREMATURE
DEATH

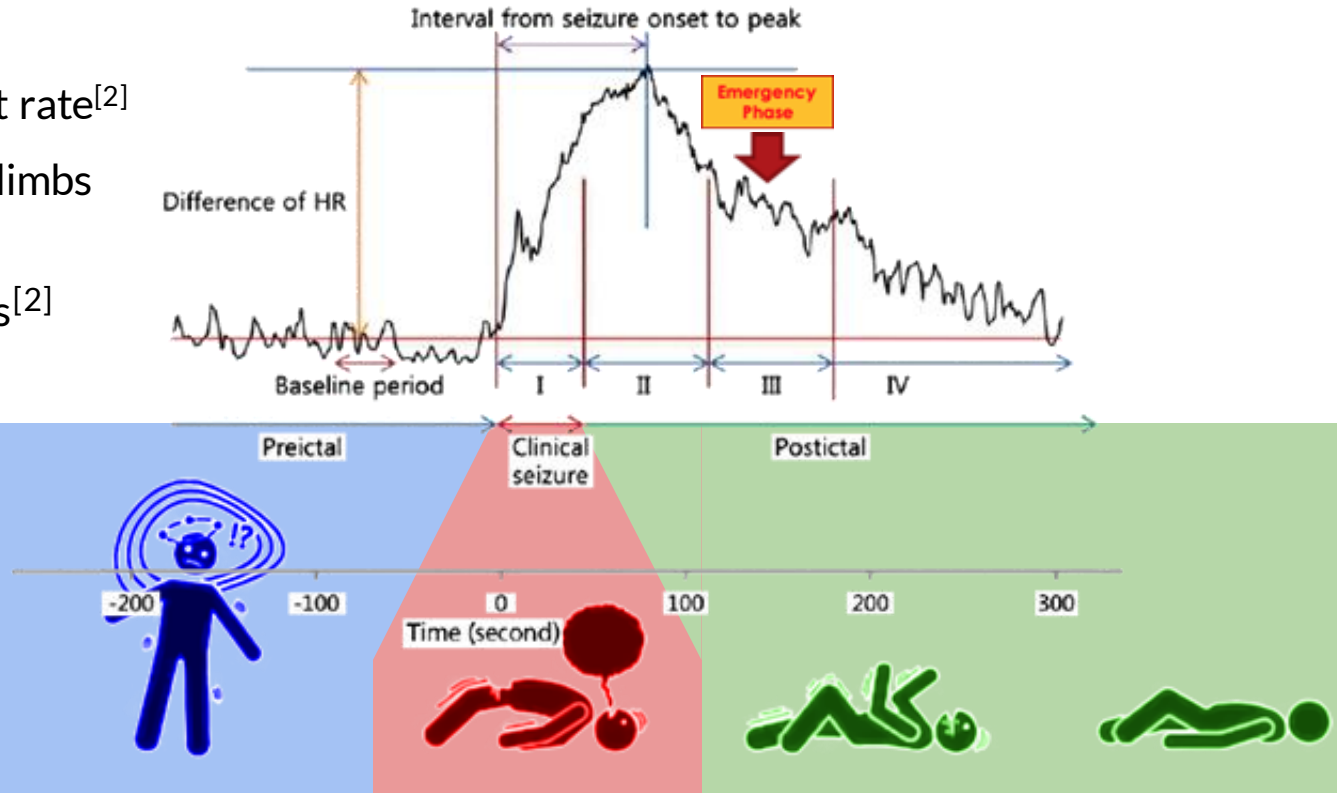


CAUSES OF TREATMENT GAP:

- lack of trained staff
- poor access to anti-epileptic medicines
- societal mis conceptions
- poverty
- low prioritization for the treatment of epilepsy

Characteristics of Generalized Seizures

- Rapid change in heart rate^[2]
- Rapid convulsions in limbs and face^[2]
- Loss of consciousness^[2]





Problem Statement

- Epileptic seizures are difficult to detect in a timely and accurate fashion and undetected seizures can result in injury or even death.
- Current smartwatch detection technology does not provide an 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 that tune detection variables to match individual patient seizure characteristics.
- Existing solutions to detect seizures use smartwatch technology which must be in the proximity of a smartphone in order to notify emergency contacts.



Who is Affected

- Epilepsy affects those all ages; from young children to seniors^[3].
- Approximately 25% of individuals diagnosed with Epilepsy have generalized tonic-clonic seizures^[3].
- Epilepsy is more likely to affect those who:
 - are autistic,
 - have experienced a stroke,
 - or have suffered a significant infection or head trauma^[4].

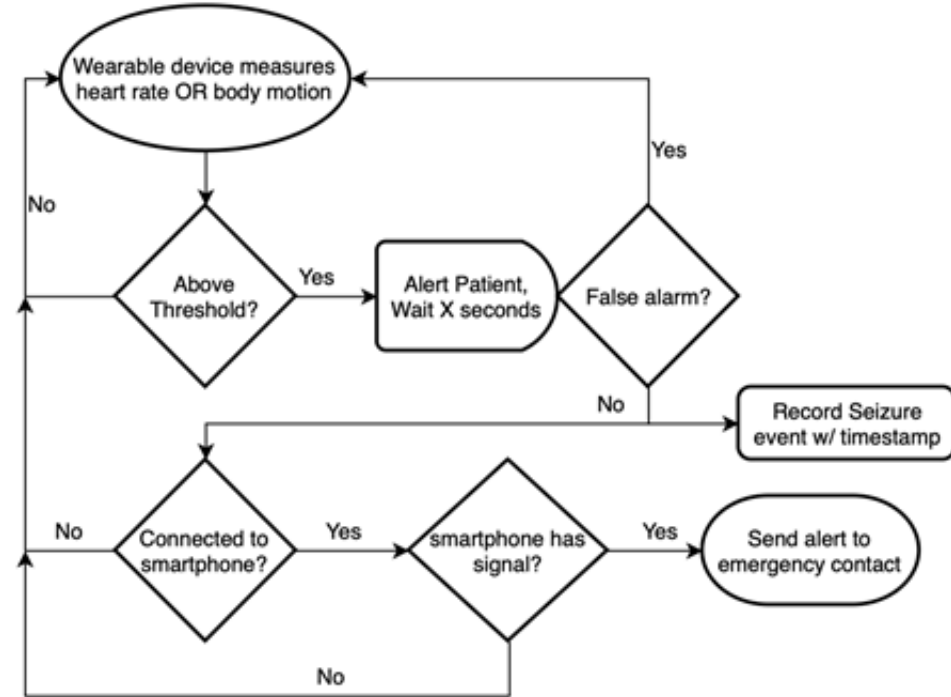


Problem Characteristics

- Existing technology relies on the detection of an increase in heart rate or repetitive body movements (but not both) to confirm the onset of a seizure.
- Concurrent recognition of repetitive body movements and a rapid change in heart rate is essential for achieving high accuracy of results and low false positive risk of a seizure detecting device.
- Current solutions do not offer 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 in order to notify emergency contacts.
- Available solutions capable of detecting, tracking, and reporting seizures require subscription services, prescriptions, or both.

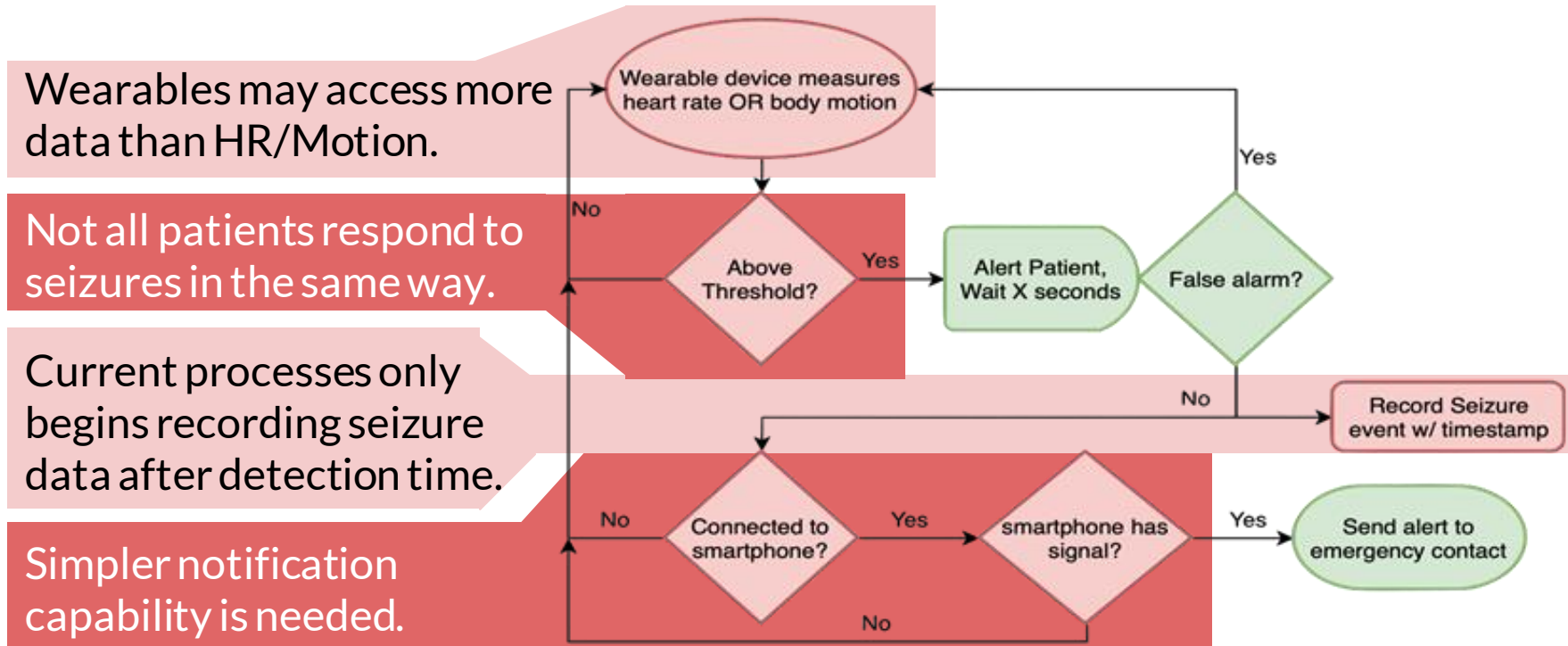
Current Process Flow

- 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 from combined heart rate **and** motion metrics,
- Detect seizures using an algorithm which matches individual patient seizure characteristics,
- track and record all information surrounding seizure events,
- and provide automatic notification to emergency contacts without requiring a relay.

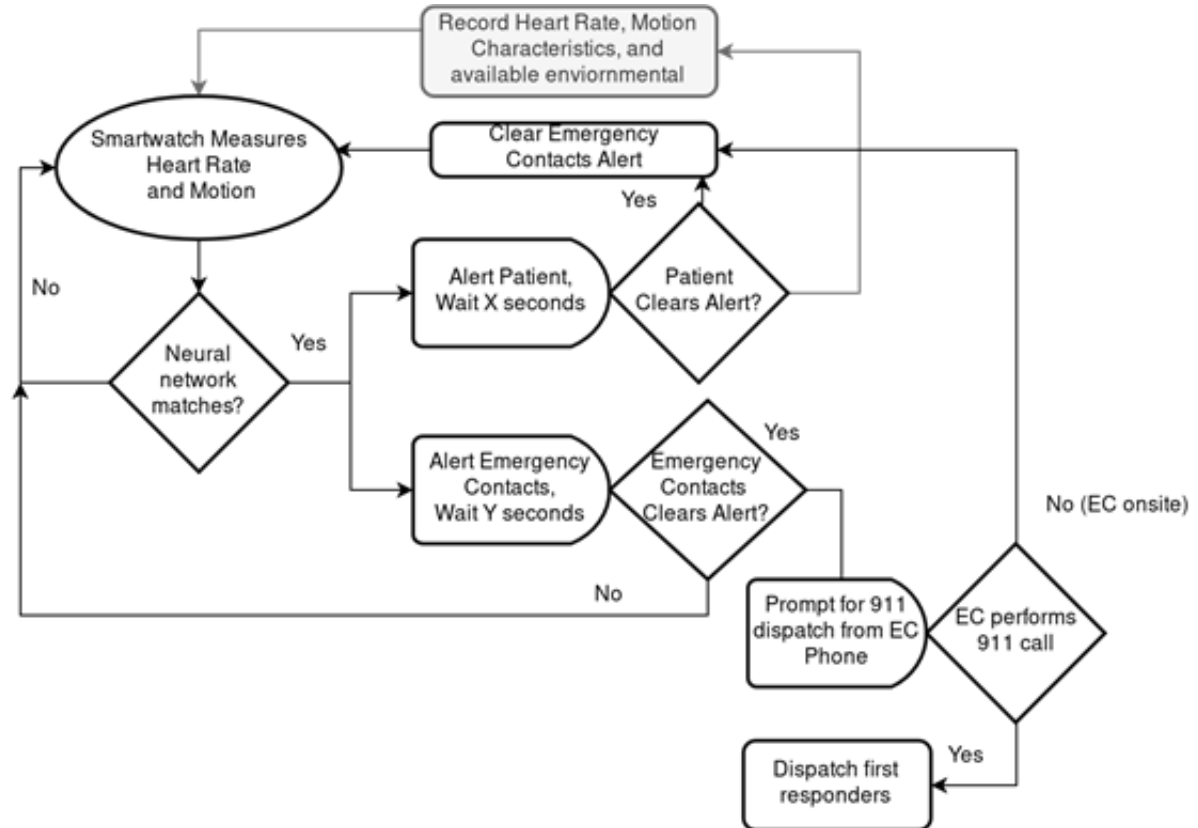


Solution Characteristics

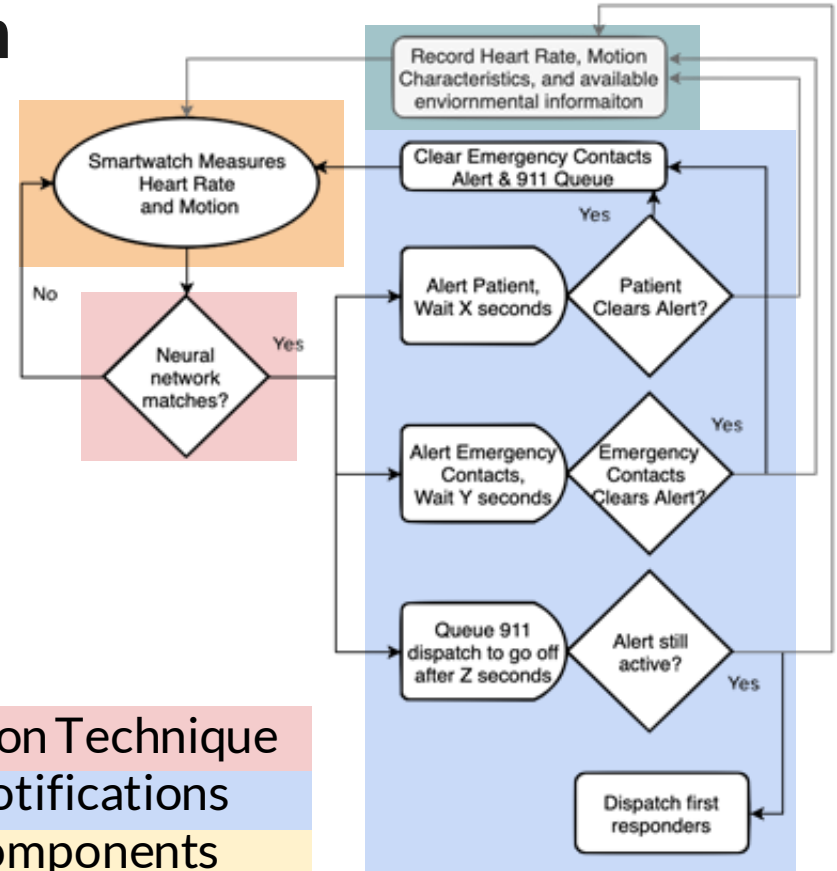
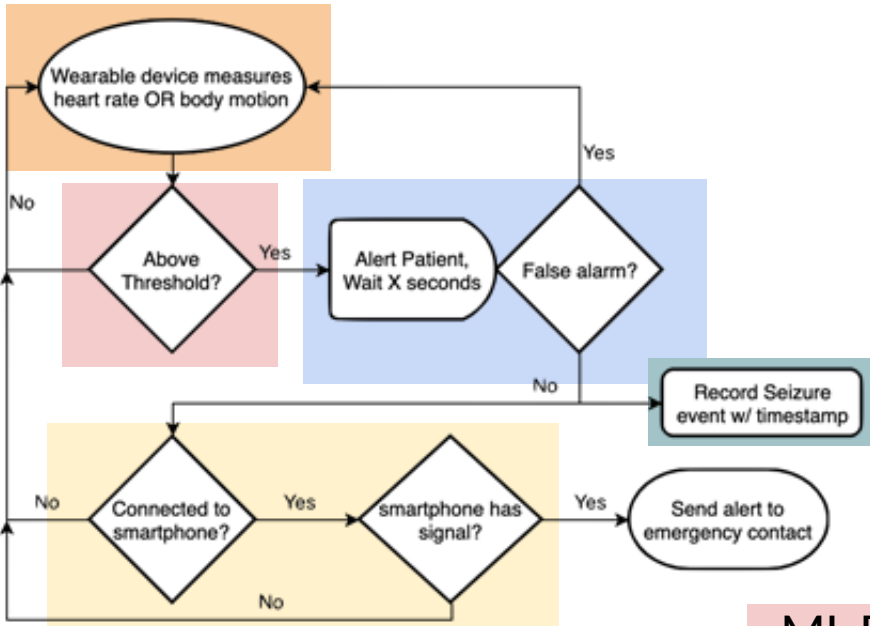
- Smartwatch technology is used for detection, tracking, and recording of generalized seizures.
- Machine learning technology is used to evaluate heart rate and body motion characteristics to establish a seizure profile for each patient.
- Heart rate performance and body motion are continuously monitored.
- 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.

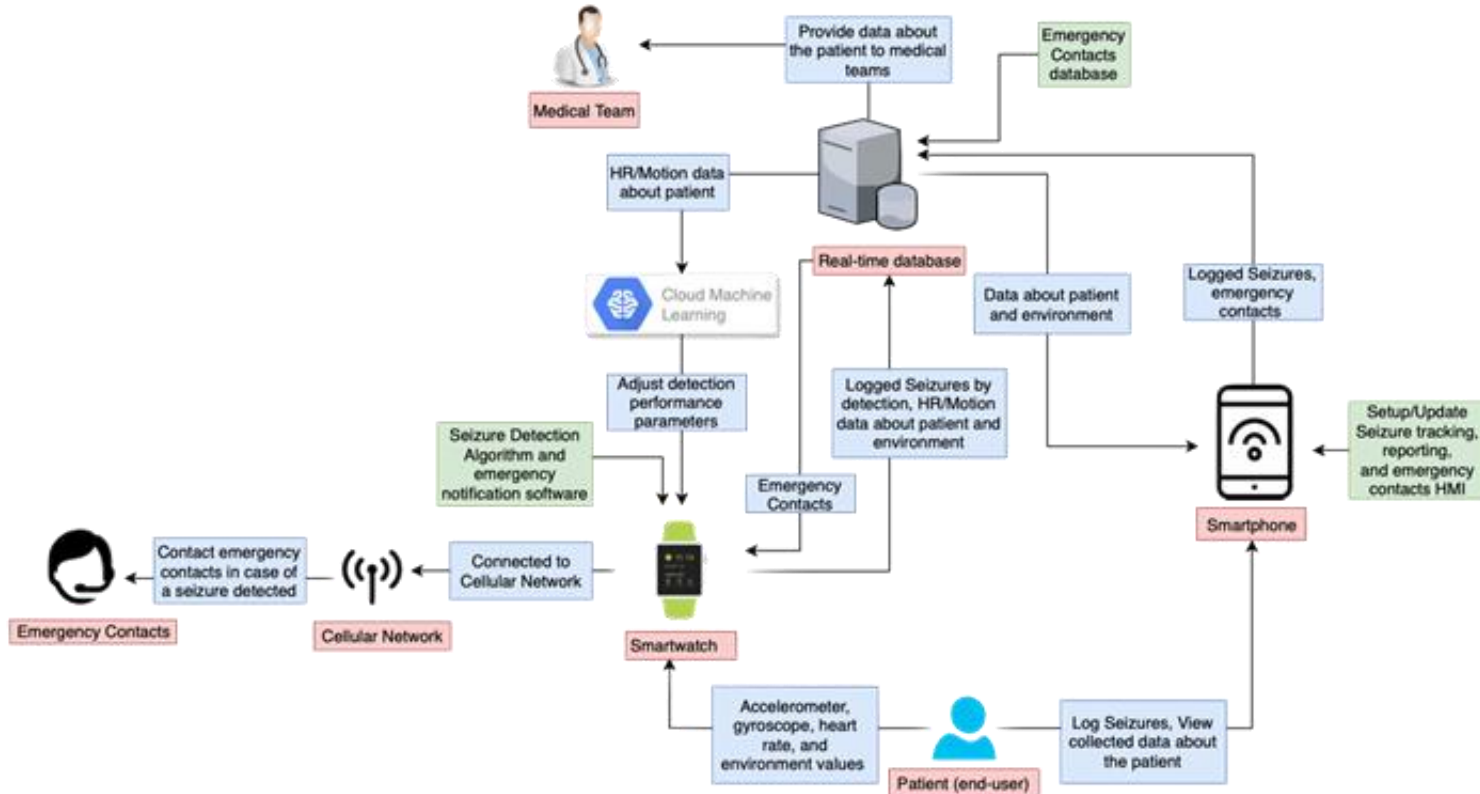


Process Flow Comparison



Measures >1 Data Point	ML Detection Technique
Records all event data	Tiered Notifications
	Fewer components

Major Functional Component Diagram



Competition Matrix

			Direct		Indirect	
	<u>SeizSmart</u>	<u>SmartMonitor</u>	<u>empatica embrace 2</u>	<u>SeizAlarm</u>	<u>Epilepsy Journal</u>	<u>Epilepsy Health Storylines</u>
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	✓	✓	✓	✓	✗	✗
Report 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 in advance of known symptoms
- 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.





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