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## EpiSleeve: Multimodal Night-time Seizure Detection

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# EpiSleeve: Multimodal night-time seizure detection

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Department of Biomedical Engineering

Professor Matt Williams  
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Fall 2020

# Presentation Overview

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- 1 User needs
- 2 Existing Devices
- 3 Project Concept
- 4 Concept Selection
- 5 Device Design
- 6 Verification
- 7 Acknowledgements

# User Needs statement

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A comfortable, wireless, **night-time** monitoring device for individuals ages 6+ that will alert caregivers during a seizure event, visually display duration of seizure, **alert emergency services** in the event the caregiver is not present and the seizure has lasted **longer than five minutes**, and keep a **virtual record** of seizure frequency and duration.

## Why night-time?

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- \* Sleeping alone - risk factor for SUDEP
- \* Difficult to record seizures at night

## Why 5 minutes?

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- \* Seizures >5 min are a medical emergency
- \* If caregiver cannot arrive, device calls EMS

## Why keep virtual records?

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- \* Necessary to form and evaluate a treatment plan

# Current epileptic monitoring devices have similar challenges

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Movement + heart rate



Movement, temperature,  
electrodermal activity



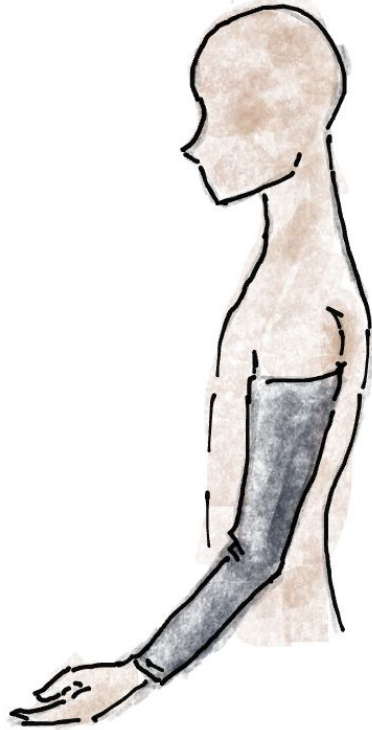
Limited to tonic-clonic  
seizures

Many require smartphones  
and WiFi

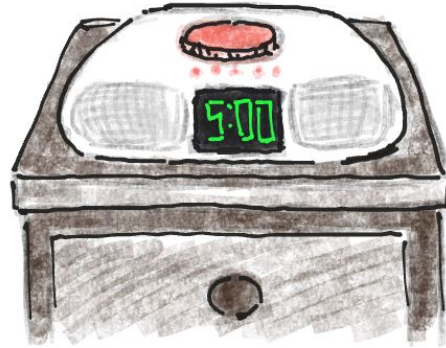
Devices, subscription plans,  
batteries

# Project Concept

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Wearable Device



Base Station



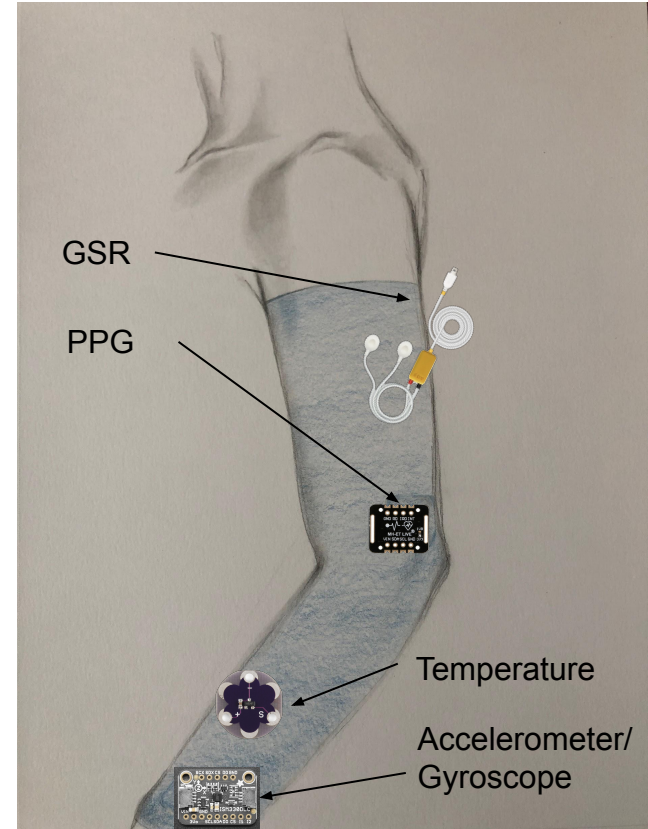
Mobile or Desktop  
Application

# Concept Selection

Criteria	Weight (%)	NightWatch	1) Shirt		2) Torso Bands		3) Stickers		4) Sleeve	
			Rating	Factor	Rating	Factor	Rating	Factor	Rating	Factor
Multi-modality	13	DATUM	+	13	+	13	+	13	+	13
Portability	7		S	0	S	0	S	0	S	0
Aesthetics	5		S	0	-	-5	S	0	S	0
Comfort	20		-	-20	-	-20	-	-20	S	0
Likelihood of noise/artifacts	13		-	-13	S	0	S	0	-	-13
Signal measurement reliability	13		+	13	+	13	+	13	+	13
Complexity of use	12		S	0	S	0	-	-12	S	0
Durability	7		-	-7	-	-7	-	-7	-	-7
Design complexity	5		-	-5	-	-5	-	-5	-	-5
Cost	5		S	0	S	0	S	0	S	0
Total	100			-19		-11		-18		1

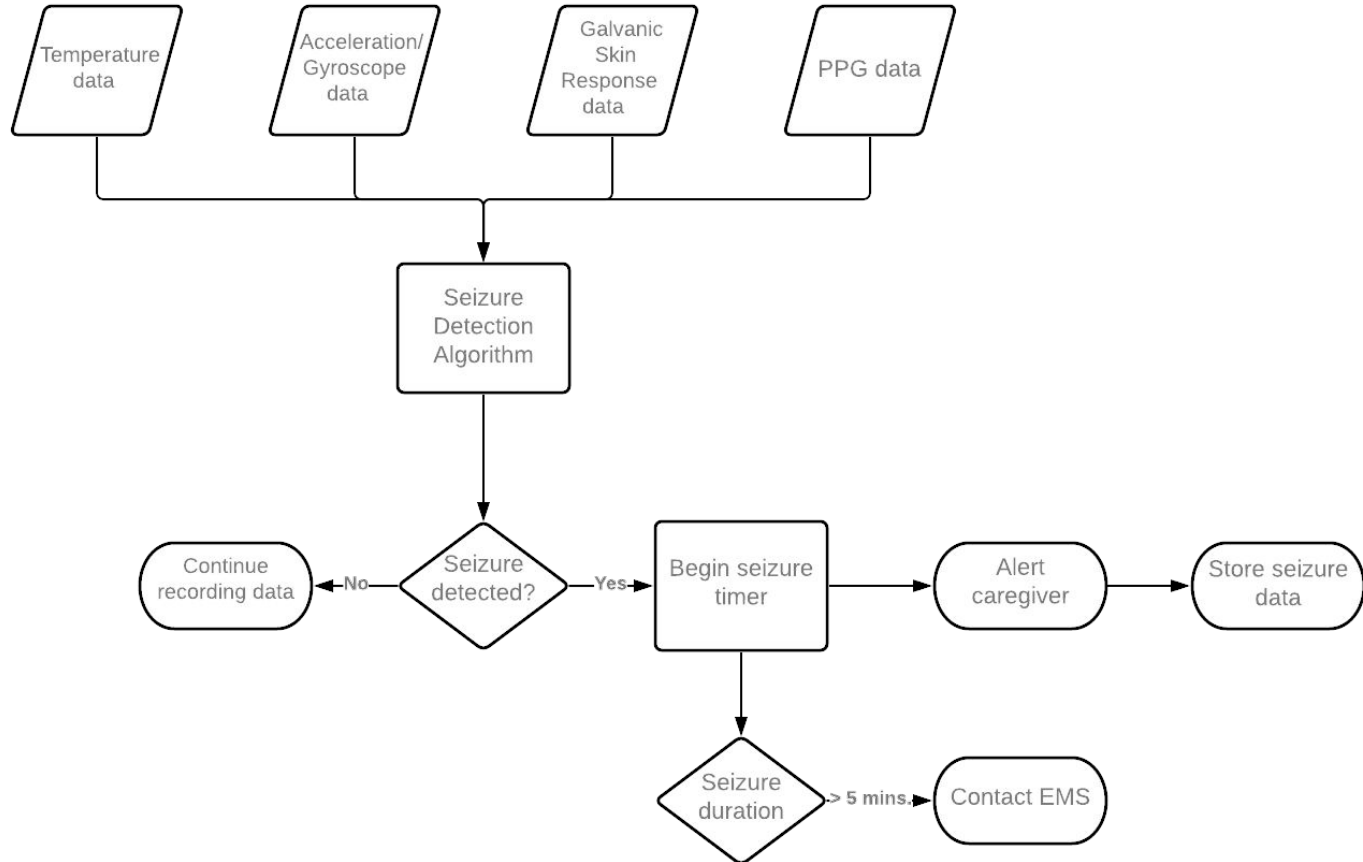
# Wearable Device

- Nylon/spandex fabric sleeve
  - Fabric pockets to house modules
- Biosignal sensors
  - Photoplethysmography (PPG)
  - Galvanic skin response (GSR)
  - Temperature
  - Accelerometer/Gyroscope
- Wireless data transmission
  - Biosensing board
- Rechargeable battery





# Base Station



# Verification Plan

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- Design specifications focus on sensor readouts
  - All sensors compatible with Arduino
  - Accuracy verified via test against standard equipment
    - Temperature -> external oral thermometer
    - Acceleration/Gyroscope -> external positioning
    - Galvanic skin response -> external multimeter
    - Photoplethysmography -> external  $S_pO_2$  and HR sensors
- User specifications verified via simulation
- Safety specifications verified via visual inspection

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