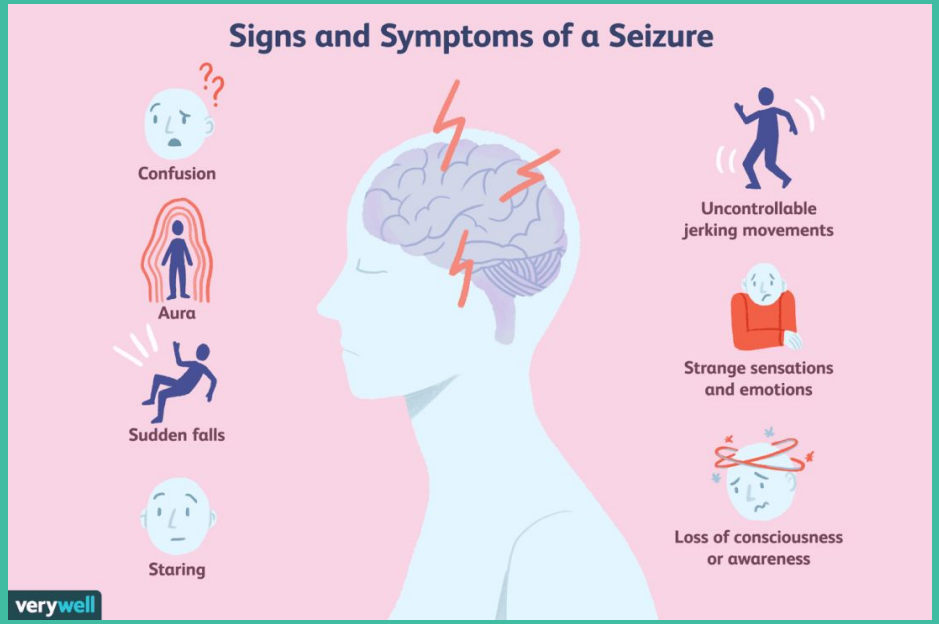
SEIZURE DETECTION USING A WEARABLE SENSOR

Team FitByters

Introduction

What is a Seizure?

- A sudden, uncontrolled electrical disturbance in the brain.
- Disruption in Electrical Pulse Patterns of the brain.
- Brain cells moving simultaneously at a faster rate than normal.
- Spreading to different parts of the brain, leading to sensations, awareness and movement changes.
- Maybe severe or subtle.
- May lead to SUDEP



Project Objectives

Detecting and Avoiding Seizures and Preventing SUDEP

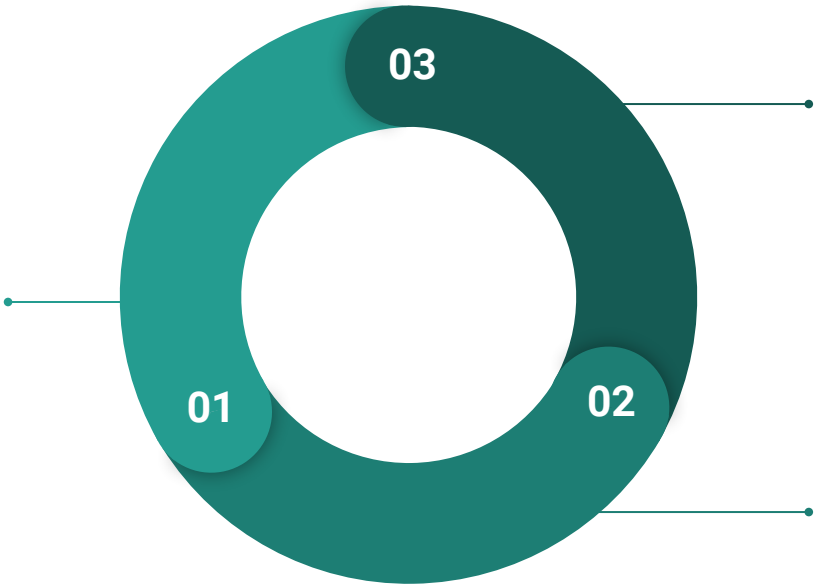
1. **Design a system that can detect the event of seizures in an epilepsy patient in real-time.**
2. **Relay the information via an application to dear ones.**
3. **Transmit the GPS location of the epilepsy patient in the event of a seizure.**

System Devices

Sensor

Bluetooth 2.0 Gyro Sensor BWT901CL

-Gyro accelerometer + geomagnetic field sensor
-Serial port TTL level Interfacing



Application

FitByte

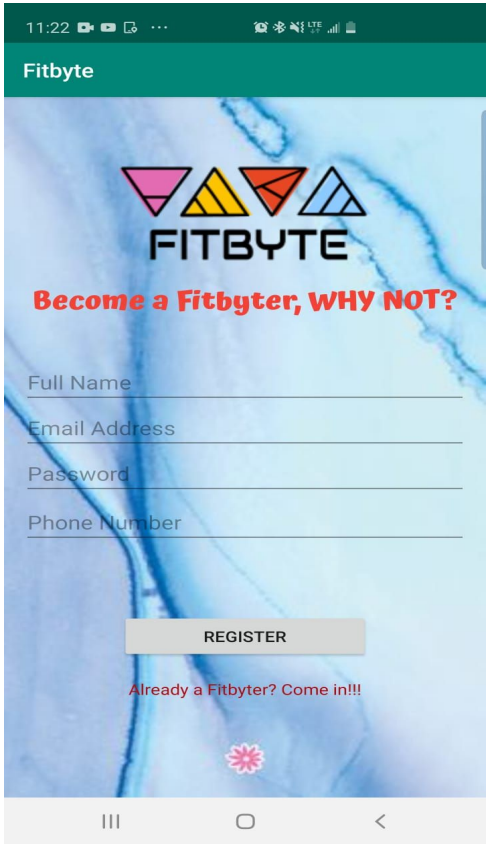
-Android Studio
-Google Cloud Firestore

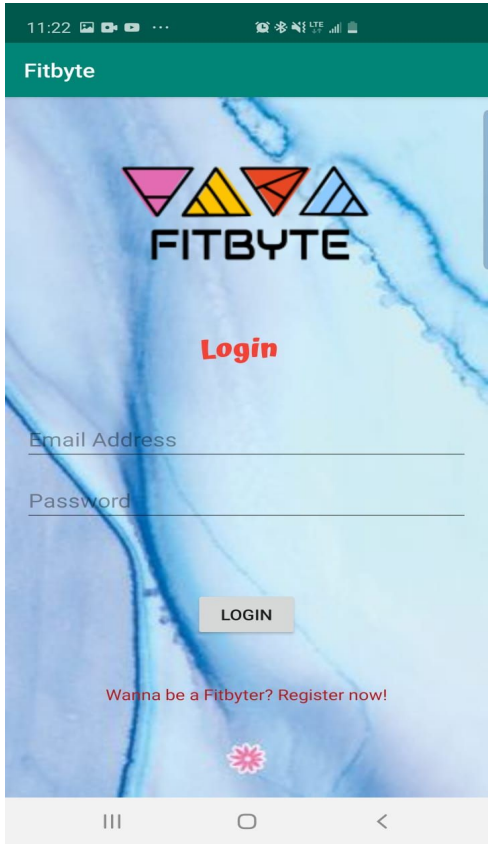
Processor

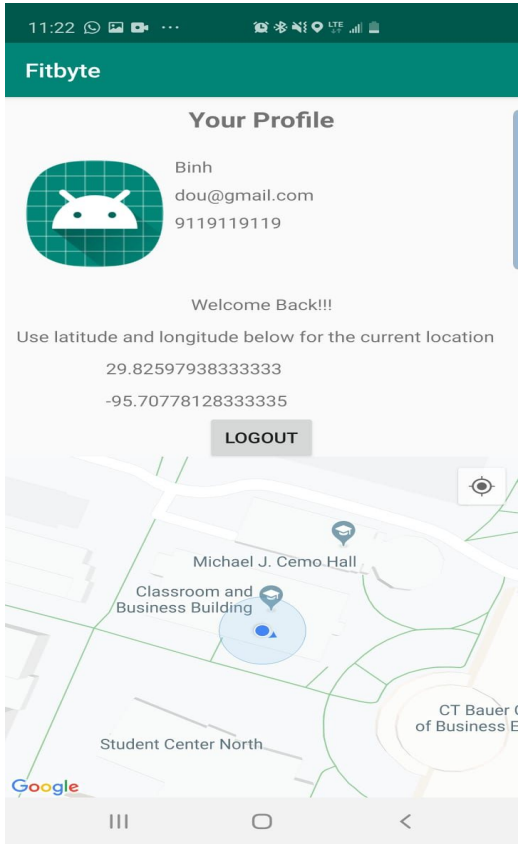
Raspberry Pi 4

-Silent, energy-efficient
-Fast networking

FitByte App


11:22
Fitbyte
FITBYTE
Become a Fitbyter, WHY NOT?
Full Name
Email Address
Password
Phone Number
REGISTER
Already a Fitbyter? Come in!!!


11:22
Fitbyte
FITBYTE
Login
Email Address
Password
LOGIN
Wanna be a Fitbyter? Register now!


11:22
Fitbyte
Your Profile
Binh
dou@gmail.com
9119119119
Welcome Back!!!
Use latitude and longitude below for the current location
29.82597938333333
-95.70778128333335
LOGOUT
Michael J. Cemo Hall
Classroom and
Business Building
Student Center North
Google

The “Brain”

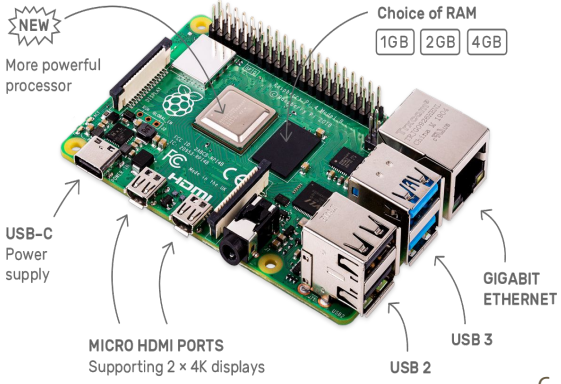
4G LTE Base shield HAT

Antenna - 100mm

Quectel EC25 Mini PCIe 4G/LTE Module

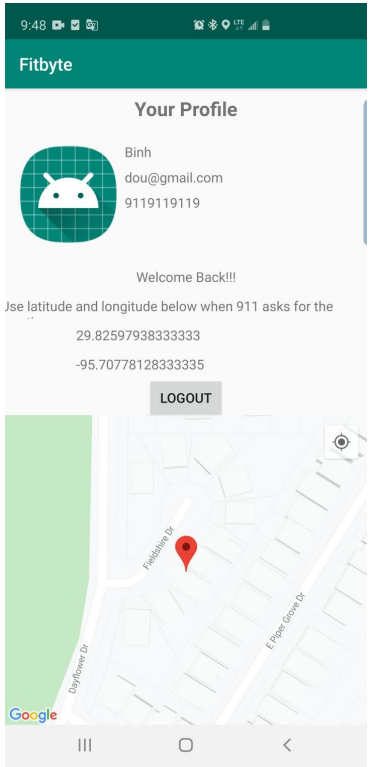
ASUS USB-BT400 w/Bluetooth Dongle

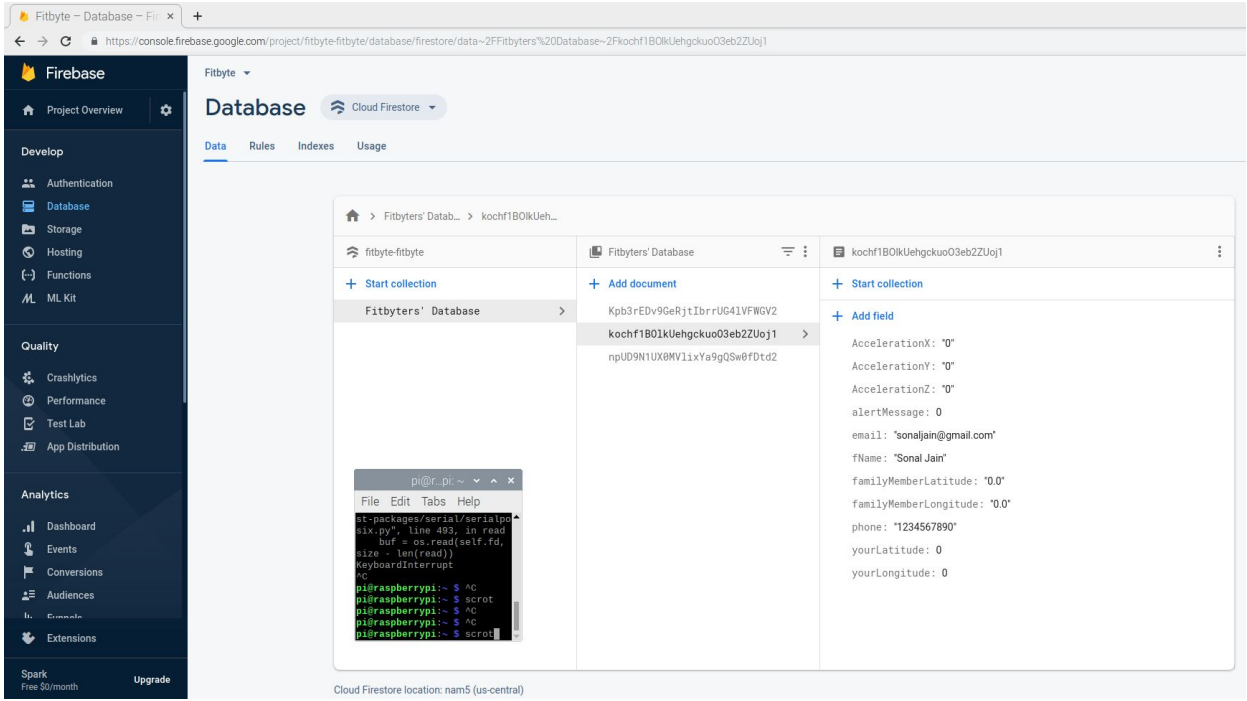
WitMotion BWT901CL Bluetooth mpu9250 + Gyro + Accelerometer(Triple Axis) +Angle+Magnetometer



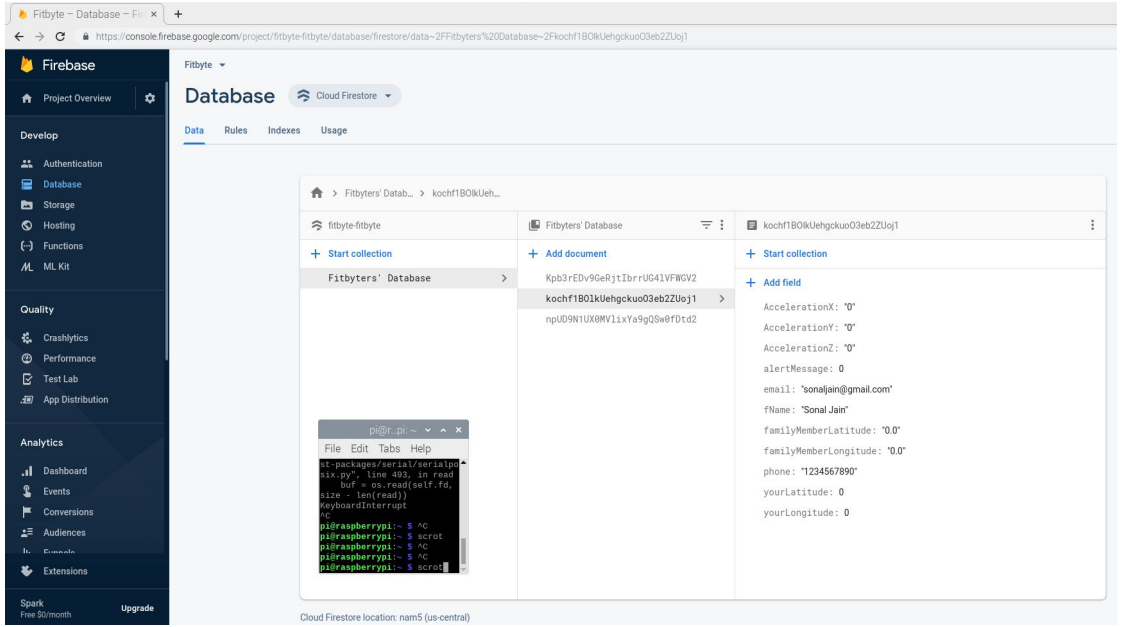
Raspberry Pi 4

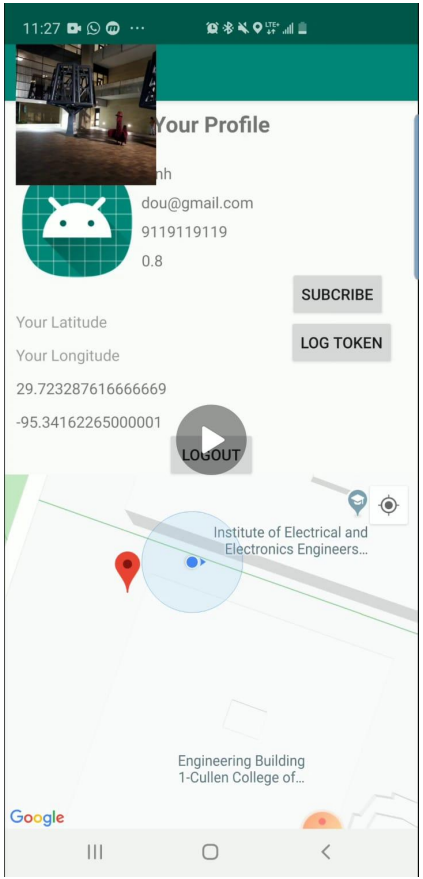
FitByte


9:48
Fitbyte
Your Profile
Binh
dou@gmail.com
9119119119
Welcome Back!!!
Use latitude and longitude below when 911 asks for the
29.82597938333333
-95.70778128333335
LOGOUT
Google


Fitbyte – Database – Fir
https://console.firebase.google.com/project/fitbyte-fitbyte/database/firestore/data~2FFitbyters%20Database~2Fkochf1BOlkUehgckuoO3eb2ZUoj1
Firebase
Project Overview
Develop
Authentication
Database
Storage
Hosting
Functions
ML Kit
Quality
Crashlytics
Performance
Test Lab
App Distribution
Analytics
Dashboard
Events
Conversions
Audiences
Extensions
Spark
Free $0/month
Upgrade
Fitbyte
Database
Cloud Firestore
Data
Rules
Indexes
Usage
fitbyte-fitbyte
Start collection
Fitbyters' Database
Fitbyters' Database
Add document
Kpb3rEDv9GeRjtIbrrUG41VFWGV2
kochf1BOlkUehgckuoO3eb2ZUoj1
npUD9N1UX0MVlixYa9gQSw0fDtd2
kochf1BOlkUehgckuoO3eb2ZUoj1
Start collection
Add field
AccelerationX: "0"
AccelerationY: "0"
AccelerationZ: "0"
alertMessage: 0
email: "sonaljain@gmail.com"
fName: "Sonal Jain"
familyMemberLatitude: "0.0"
familyMemberLongitude: "0.0"
phone: "1234567890"
yourLatitude: 0
yourLongitude: 0
File Edit Tabs Help
KeyboardInterrupt
pi@raspberrypi:~ $ ^C
pi@raspberrypi:~ $ scrot
Cloud Firestore location: nam5 (us-central)

GPS Location

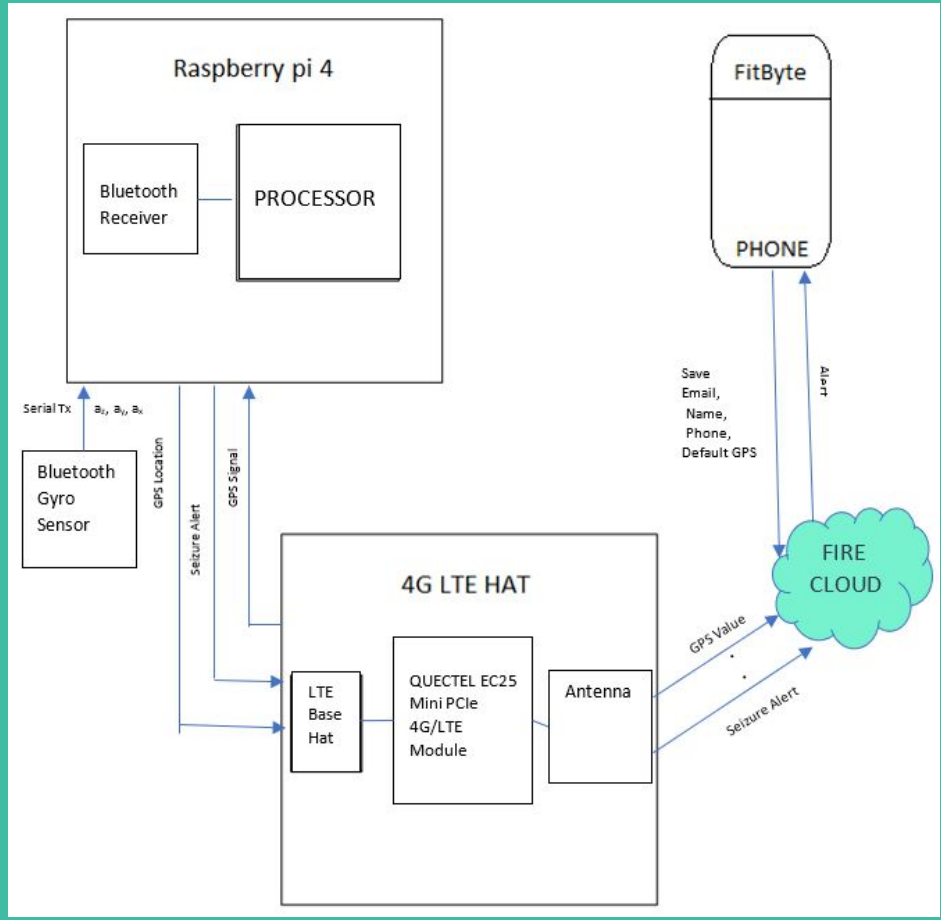




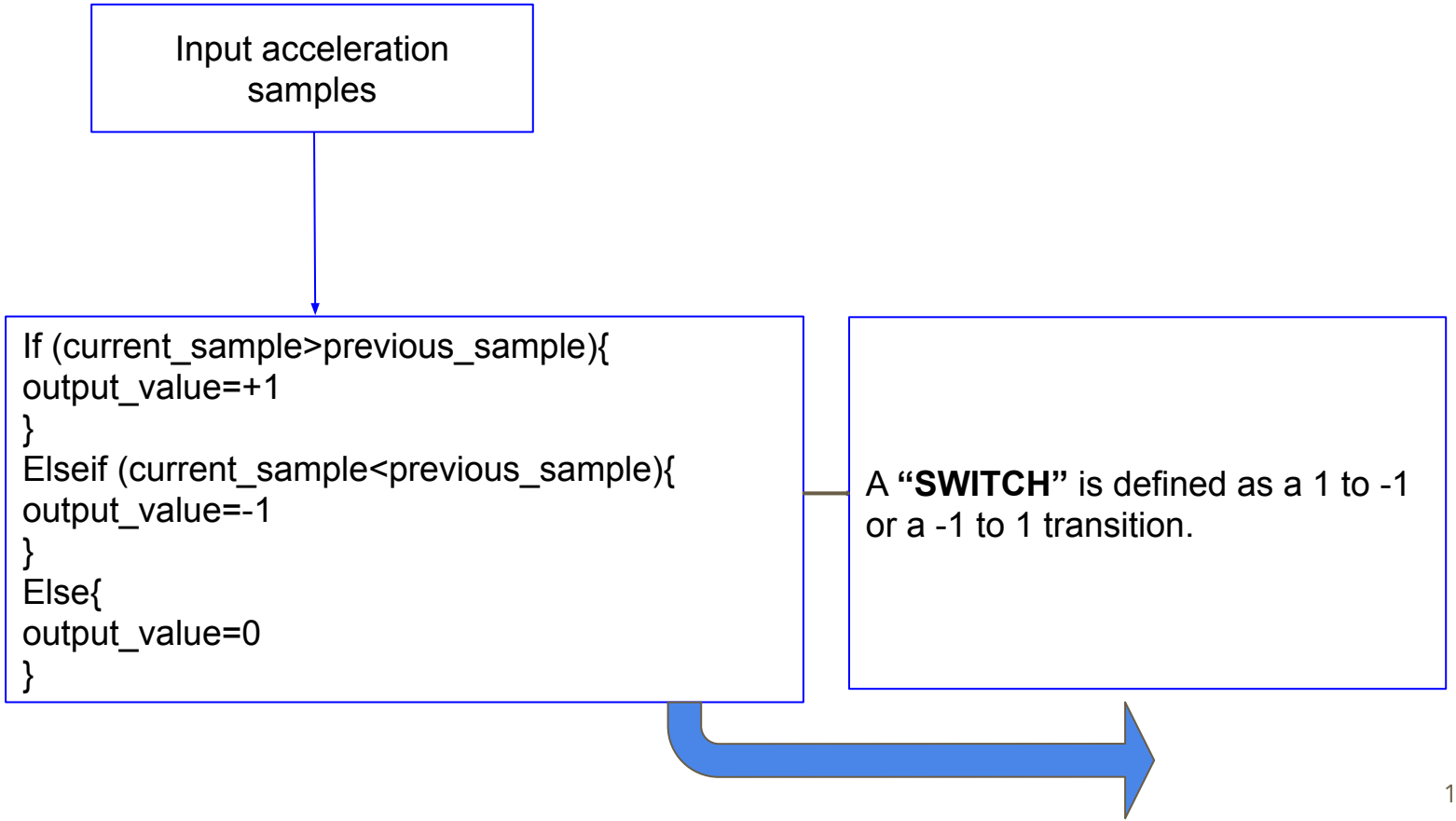
System Architecture

The Seizure Detection System comprises:

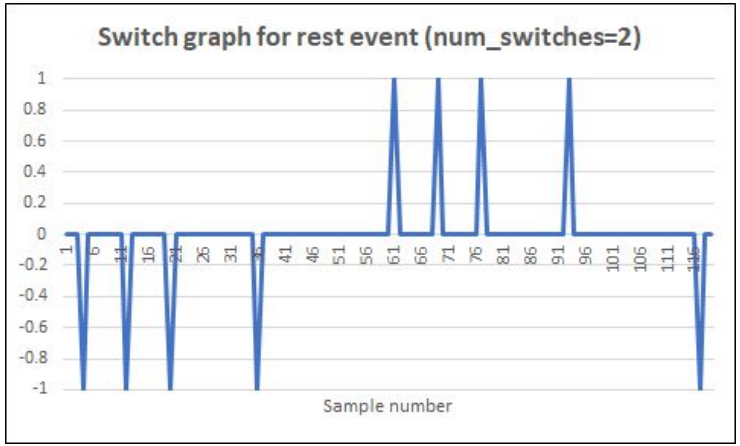
1. Bluetooth Gyro Sensor
2. Asus Bluetooth Transceiver
3. Raspberry Pi 4 Processor
4. 4G/LTE HAT :
   a. LTE Base HAT
   b. QUECTEL EC25 Mini PCIe 4G/LTE Module
   c. Antenna
5. FitByte

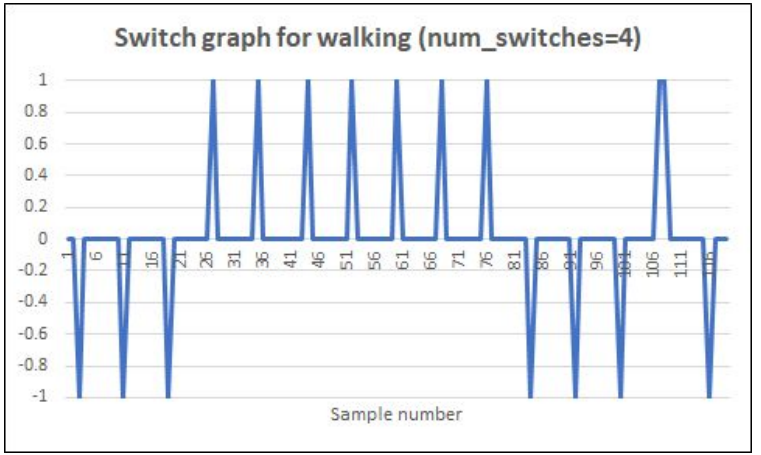


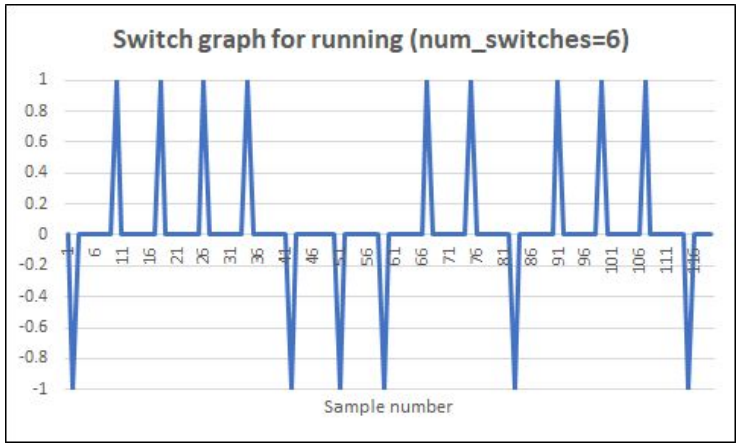
Acceleration samples processing technique

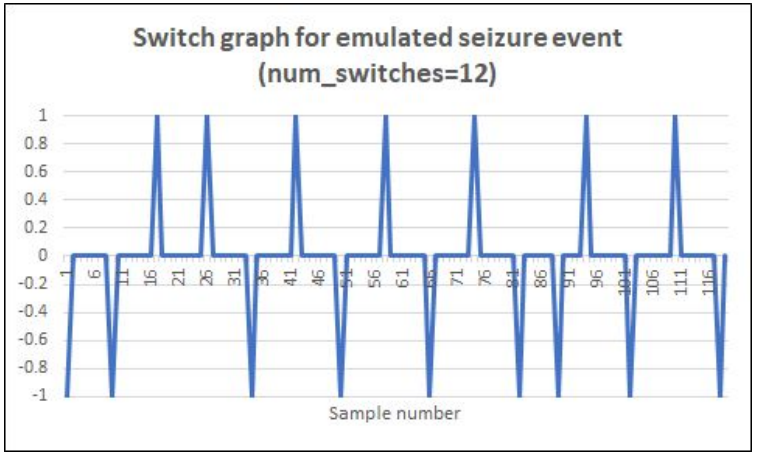


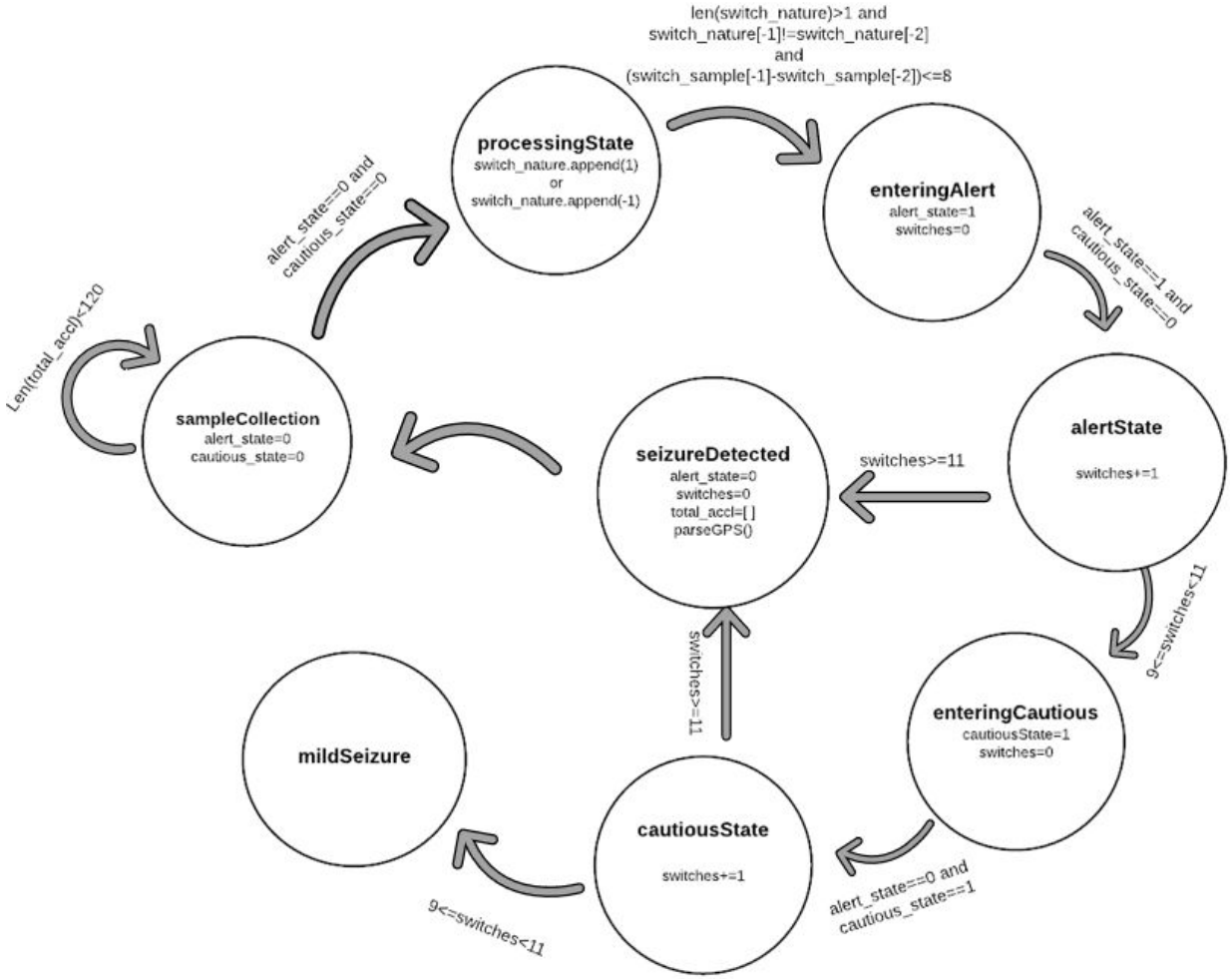
Switch samples





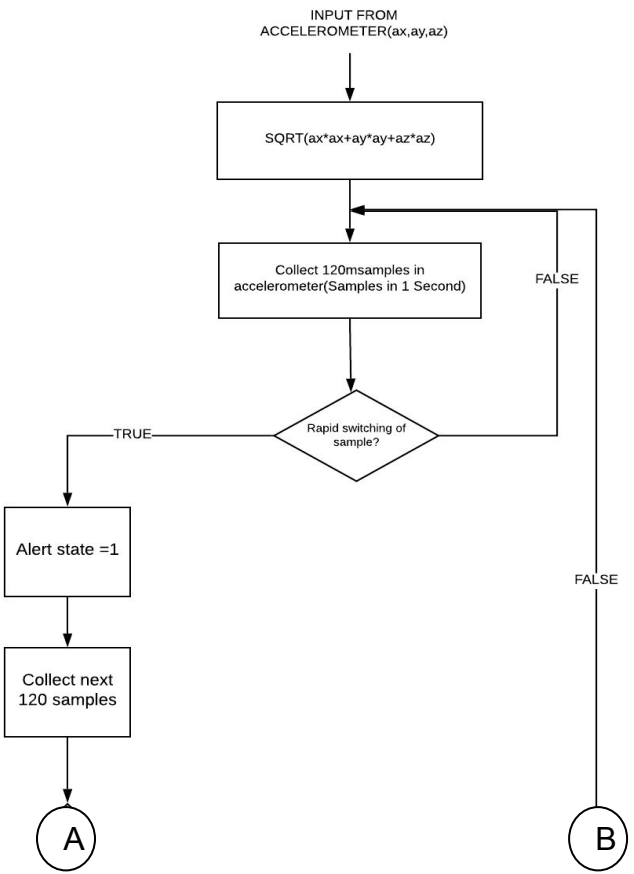


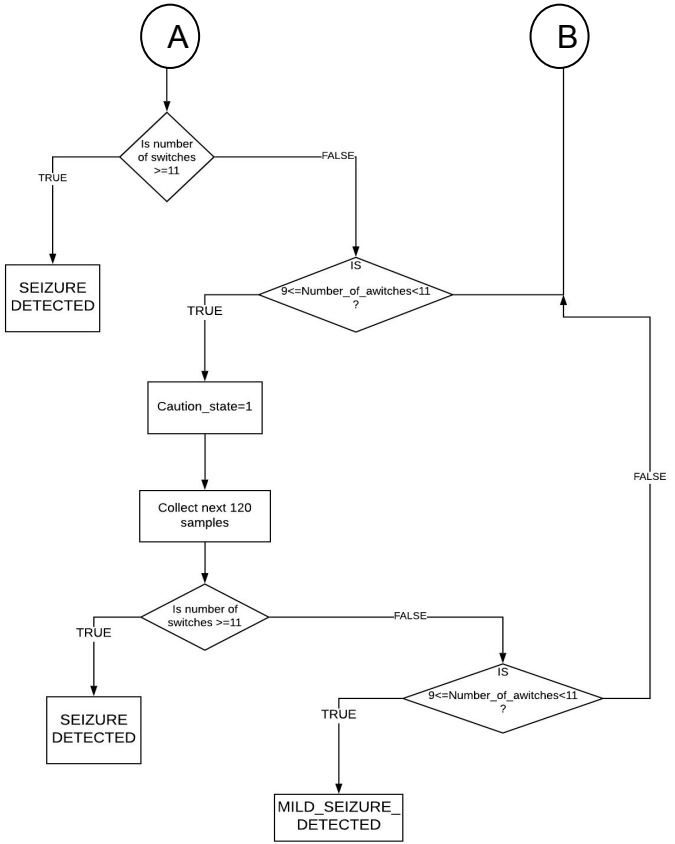




Finite State Machine of the System

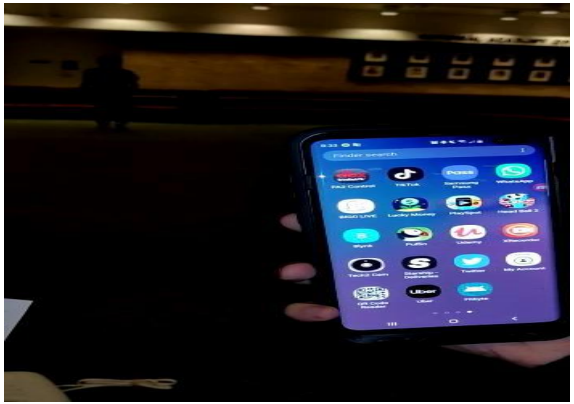
Flowchart


INPUT FROM ACCELEROMETER(ax,ay,az)
SQRT(ax*ax+ay*ay+az*az)
Collect 120msamples in accelerometer(Samples in 1 Second)
Rapid switching of sample?
TRUE
FALSE
Alert state =1
Collect next 120 samples
A
B
FALSE

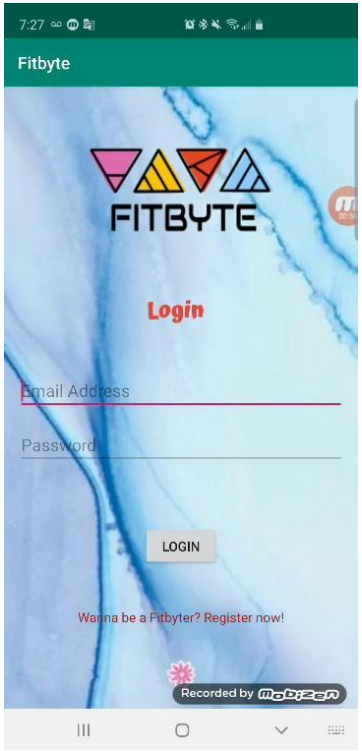

A
B
Is number of switches >=11
TRUE
FALSE
SEIZURE DETECTED
IS 9<=Number_of_awitches<11 ?
TRUE
Caution_state=1
Collect next 120 samples
FALSE
Is number of switches >=11
TRUE
FALSE
SEIZURE DETECTED
IS 9<=Number_of_awitches<11 ?
TRUE
MILD_SEIZURE_ DETECTED

Seizure

True Negative case



FitByte



System Demonstration

Acknowledgement

1. Dr. Yuhua Chen
2. Shreyas Poyrekar

References

1. Lliwen A Jones and Rhys H Thomas. Sudden death in epilepsy: Insights from the last 25 years.Seizure, 44:232–236, 2017.
2. MayoClinic.Seizures.https://www.mayoclinic.org/diseases-conditions/seizure/symptoms-causes/syc-20365711, 2019. Online; accessed 12 November 2019.
3. Yash Paul. Various epileptic seizure detection techniques using biomedical signals: a review.Brain informatics, 5(2):6, 2018.

Thank You