The Essential Tremors Monitoring System (ETMS)

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ABSTRACT/ MOTIVATION

What is Essential Tremors

- Essential tremors is a neurological condition that causes involuntary, rhythmic shaking—most commonly in the hands—especially during precise movements

Why is the ETMS important?

- A device like this doesn't exist.
- The only devices like this are very niche, expensive and for specialists only.

OBJECTIVES

- Design a device that can acquire the Essential Tremors signal and record it for further viewing
- Make it portable and cost-effective

SYSTEM BLOCK DIAGRAM

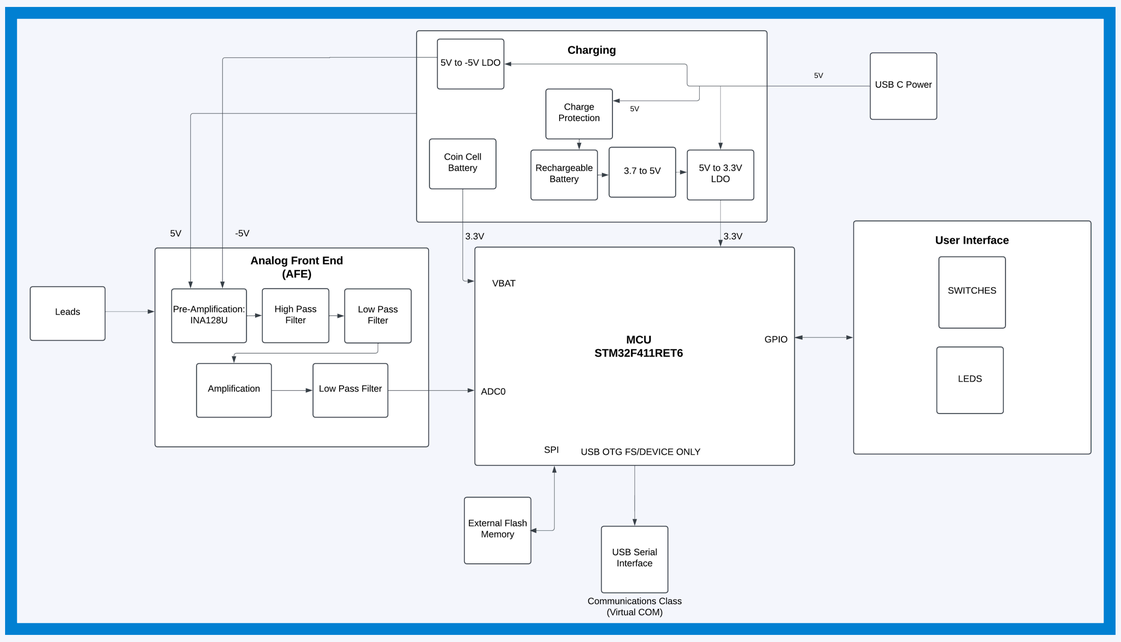

Fig 1. System Block Diagram of the Essential Tremors Monitoring System

- USB-C
  - Power in
    - Charges battery
    - Powers board when plugged in
  - Data out/in medium with terminal
- Analog Front End (AFE)
  - Amplifies & filters signals from the leads
- MCU (STM32F411RET6)
  - Receives data from AFE
  - Sends recordings to external flash IC
  - Interprets commands from UI and terminal
- User Interface
  - Buttons & LEDs controlled by MCU

RESULTS

- Figure _ shows terminal usage of the ETMS and clearing the data on the device.
- "clear" clears the external FLASH storage
- "dump" outputs all stored values

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2795,77932,3279          11,51932,3273
2795,77948,3279          11,51964,3272
2795,77964,3281          11,51980,3272
2795,78012,3279          11,51996,3272
2795,78028,3281          11,52012,3273
2795,78044,3282          11,52028,3272
2795,78060,3277          11,52044,3272
2795,78076,3278          11,52060,3276
2795,78092,3275          11,52076,3272
2795,78108,3279          11,52092,3272
2795,78124,3275          11,52108,3272
2795,78140,3279          11,52124,3275
2795,78156,3283          11,52140,3273
2795,78172,3279          11,52156,3266
2795,78188,3276          11,52172,3265
2795,78204,3279          11,52204,3272
2795,78252,3277          11,52220,3272
2795,78268,3279          clear
2795,78284,3281          Clearing Flash
2795,78300,3278
```

Fig 2. Terminal Usage

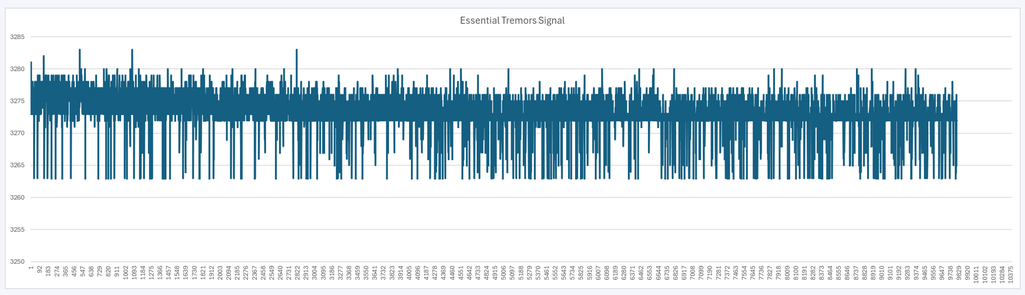

Fig 3. ETMS Reading through Excel

- Figure _ shows output of the ETMS as a plot through Excel, shows reading from a person with Essential Tremors.

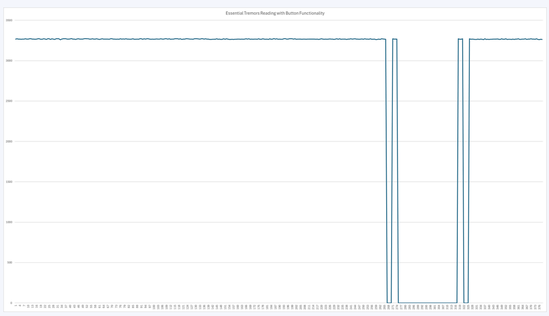

Fig 4. ETMS Reading with Button Pause

- Figure _ shows terminal usage of the ETMS with pause button functionality
- When pause button is pressed, the readings from the ADC go to zero.

DEVICE DESIGN

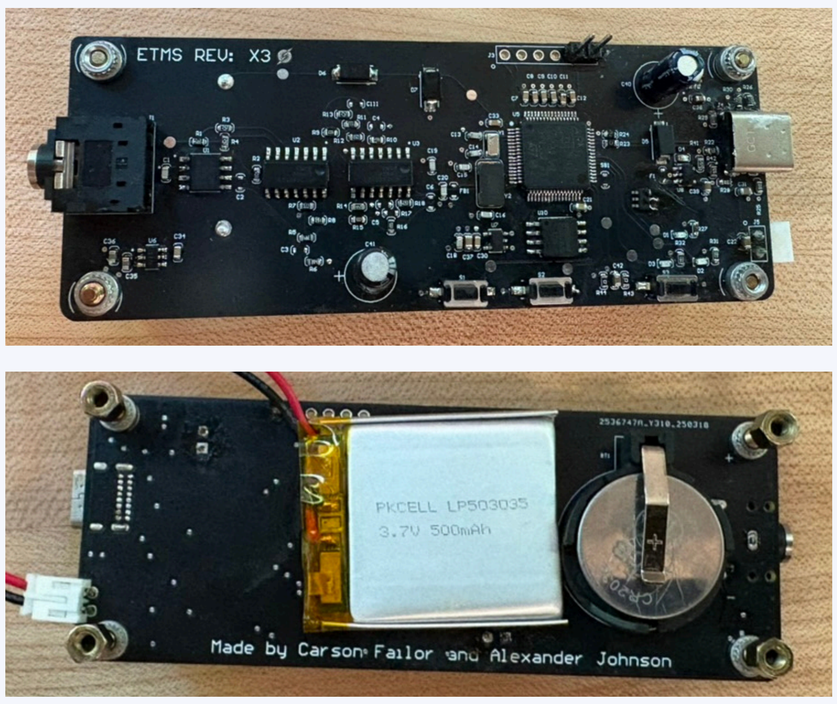

Fig 5. Final PCB

Hardware

- Programs and charges over USB-C
- Custom analog front-end
- STM32F411RET6 Microcontroller
- Four-layer PCB for power and ground planes
- Custom Charging circuit
- 500 mAh li-ion battery

FUTURE IMPROVEMENTS

Hardware Improvements

- Component Choice
  - 0603 components to 0402 components
  - Smaller coin cell batteries
  - Different operational amplifier IC's (smaller)

Software/Functionality Improvements

- Digital Signal Processing
  - Use Digital filters to process any additional noise

EQUIPMENT NEEDED/USED

- STM32CubeIDE - Main IDE used for programming and designing the firmware used by the ETMS
- STMLink - USB-to-serial debugger
- PuTTY- Terminal emulator used to obtain values and then plot in .csv
- Microsoft Excel - Used to plot .csv values into graph

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