

VITALIZE

THE FETAL MONITOR

TEAM

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MECHANICAL DESIGN PROCESS

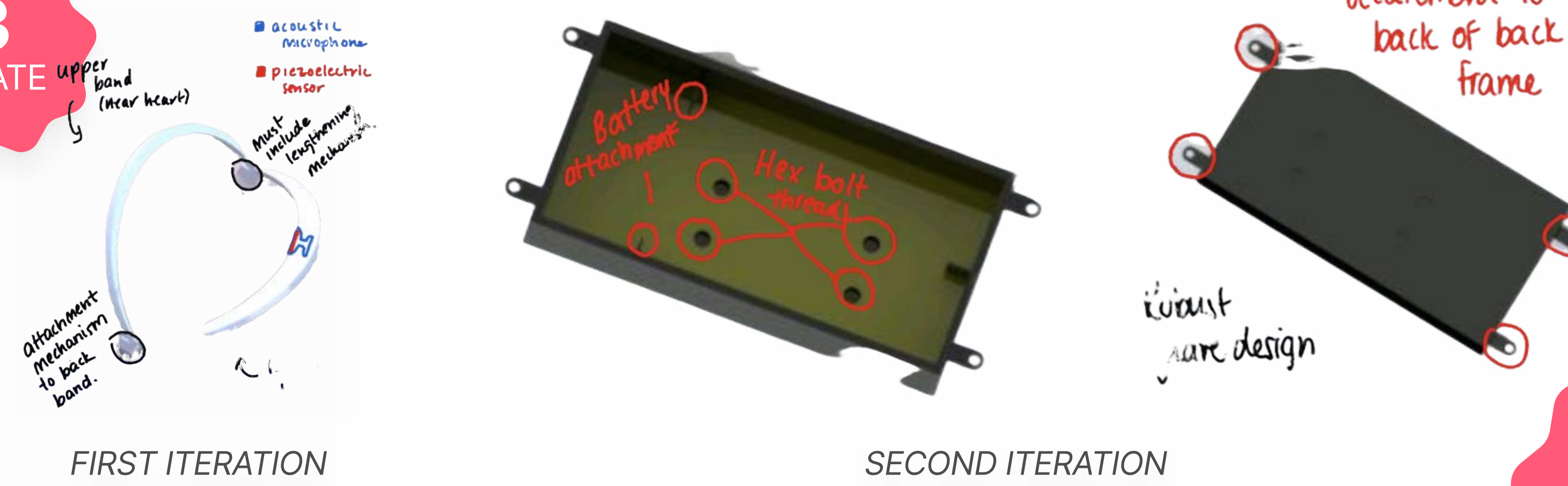
1 DEFINE

MAJOR CONSIDERATIONS → SAFETY (INSULATION), ADJUSTABILITY (EASE OF USE), AND SENSOR PLACEMENT (ACCURACY).

KEY FACTORS → TEMPERATURE CONSIDERATION (LIMIT: 30°C), PRESSURE MANAGEMENT (FETUS HEALTH), AND ADJUSTABILITY/ACCESSIBILITY (10CM TO 50CM).

2 ANALYSIS

3 IDEATE



4/5 P & T

ABOUT THE DESIGN

OUR MAJOR CONSIDERATIONS: SAFETY, FUNCTION FOR HARDWARE, COMFORT, AND AESTHETICS.

IN ADDITION TO THE HOUSING ELECTRONICS, THE ENCLOSURE INCLUDES OPTICAL PATHS TO LED LIGHTS AND A BUTTON TURN ON/OFF THE DEVICE. THE DEVICE IS INTEGRATED WITH A COTTON BAND MADE WHICH WRAPS AROUND A WOMENS BELLY. THE GOAL IS TO PROVIDE MOTHERS WITH COMFORT FOR 24/7 USE!

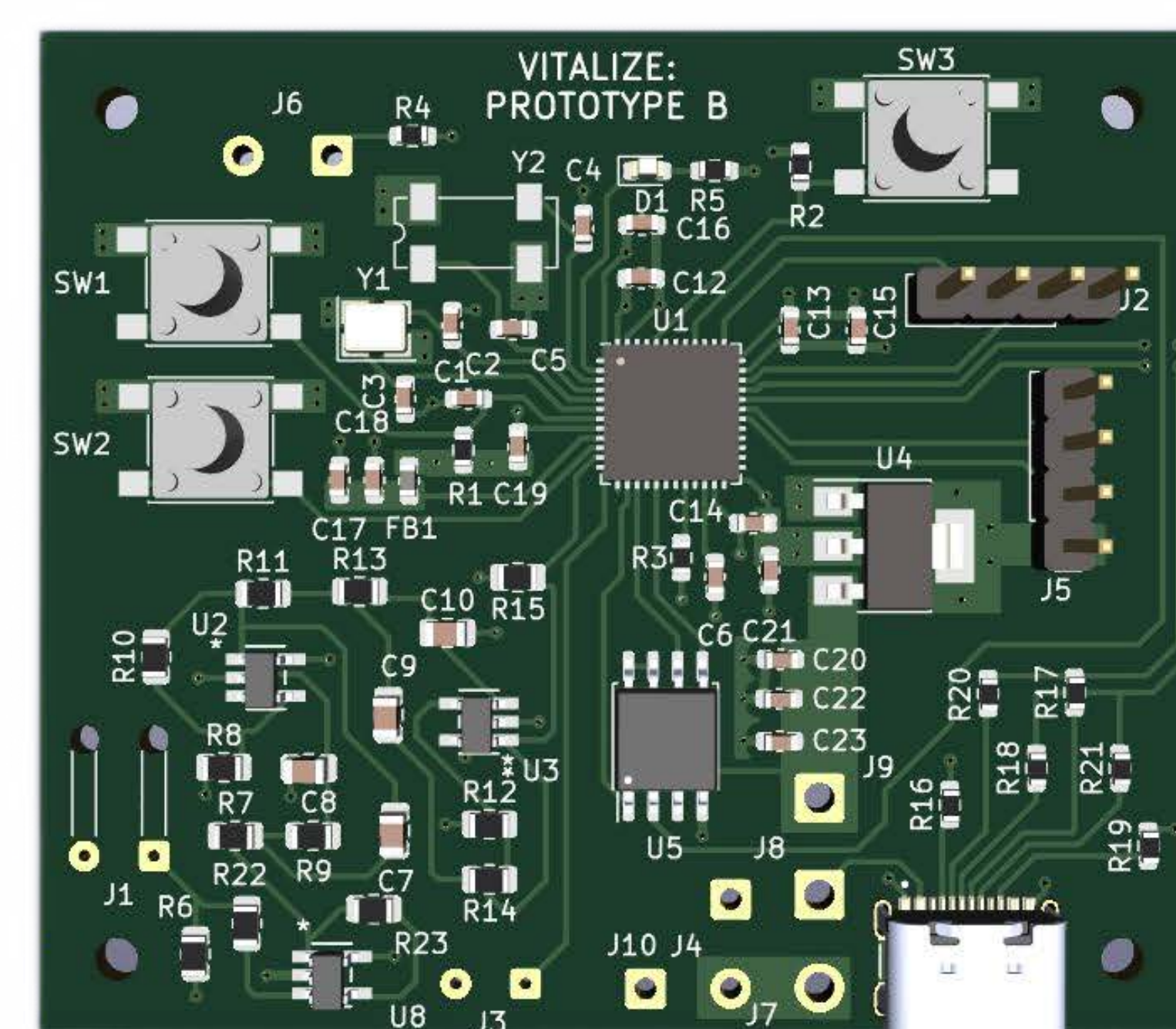


THIRD ITERATION

CORE BOARD + CHARGE

THE CORE PCB FEATURES AN STM32 MICROCONTROLLER, THAT GATHERS AND STORES SENSOR DATA AFTER ACTIVE FILTERING AND AMPLIFICATION.

THE CHARGING SYSTEM OF THE BAND IS COMPRISED OF A RECHARGEABLE 3.7V LITHIUM ION POLYMER BATTERY WITH A 2-PIN CONNECTOR, WHICH PLUGS INTO A PRE-BUILT DFR0668 CHARGING MODULE WITH USB-C CONNECTION.



- 91+ PARTS
- 4 LAYERS
- 123 NETS
- 83 VIAS
- 46 UNIQUE COMPONENTS

THE VITALIZE MISSION

VITALIZE IS RESHAPING THE FUTURE OF PRENATAL CARE WITH A STYLISH WEARABLE BAND AND USER-FRIENDLY MOBILE APP, PROVIDING EXPECTING MOTHERS AND HEALTHCARE PROVIDERS SEAMLESS AND CONTINUOUS FETAL MONITORING. EMBRACE PEACE OF MIND AND ELEVATE YOUR PREGNANCY JOURNEY - VITALIZE ISN'T JUST A PRODUCT; IT'S AN EXPERIENCE WHERE INCLUSION AND ACCESSIBILITY IS THE PRIORITY.



Mind on Your Body

TAKE CONTROL OF YOUR BABY'S HEALTH WITH OUR PORTABLE AND WIRELESS DESIGN THAT SEAMLESSLY CONNECTS TO YOUR SMARTPHONE.

THE PROBLEM

- LIMITED ACCESS TO CONTINUOUS FETAL MONITORING
- LACK OF SAFE AND PORTABLE FETAL MONITORING SOLUTION
- LIMITED SOLUTIONS WITHIN THE CANADIAN MARKET.

\$18 BILLION SPENT ON MATERNAL MENTAL HEALTH SUPPORT IN 2019. [1]

2 MILLION STILLBIRTHS THAT COULD BE PREVENTED BY SAFE, TIMELY EMERGENCY CARE, AND ACCURATE RECORDING.

REMOTE FETAL MONITORING SIGNIFICANTLY REDUCED THE RISK OF **NEONATAL ASPHYXIA BY 34%** [5]

PORTABLE WIRELESS MONITORING 24/7

AFFORDABLE AND SAFE TECHNOLOGY

DIGITAL CONNECTIVITY FOR REMOTE INCLUSION

THE SOLUTION

REMOTE MATERNAL MONITORING PRICE COMPARISON [2]

\$2050.10 vs **\$4795.69** (COST PER WOMEN)

MATERIAL & DATA

ENCLOSURE: ACRYLONITRILE BUTADIENE STYRENE (ABS) PC
FASTENERS: 4 X M2 BRASS SCREWS
FABRIC: COTTON
WEIGHT: 209.38 GRAMS (ENCLOSURE)
TEMPERATURE: 35°C
PCB CLEARANCE: 3MILLIMETERS
WATER RESISTANCE: FALSE

MANUFACTURING

2-TIER VENDOR EXPLORATION (LOCALIZATION STRATEGY) WITH SOFT TOOLED ENCLOSURES AND FABRICATED PCB. FURTHER EXPLORATION NEEDED IN ASSEMBLY AND INDUSTRIALIZATION.

DFM/DFA → EOL/ICT → DV

HARDWARE DESIGN

THE OVERALL GOAL OF THE HARDWARE TEAM IS TO CREATE A SEAMLESS TRANSITION BETWEEN THE MONITORING AND PROCUREMENT OF BIOLOGICAL SIGNALS LIKE FETAL HEART RATE (ASSISTED BY THE BIOMEDICAL LEAD) TO THE OVERALL ANALYSIS AND TRANSMISSION OF SENSOR RESULTS TO THE SOFTWARE TEAM.

PEIZOELECTRIC SENSOR

RESONANT FREQUENCY	4.2 +/- 0.5KHZ
RESONANT RESISTANCE	500 OHM MAX
CAPACITANCE	25K PF +/- 40% AT 100HZ
INPUT VOLTAGE	300VP-P MAX
OPERATING TEMPERATURE	-20 TO + 60°C
STORAGE TEMPERATURE	-20 TO + 70°C

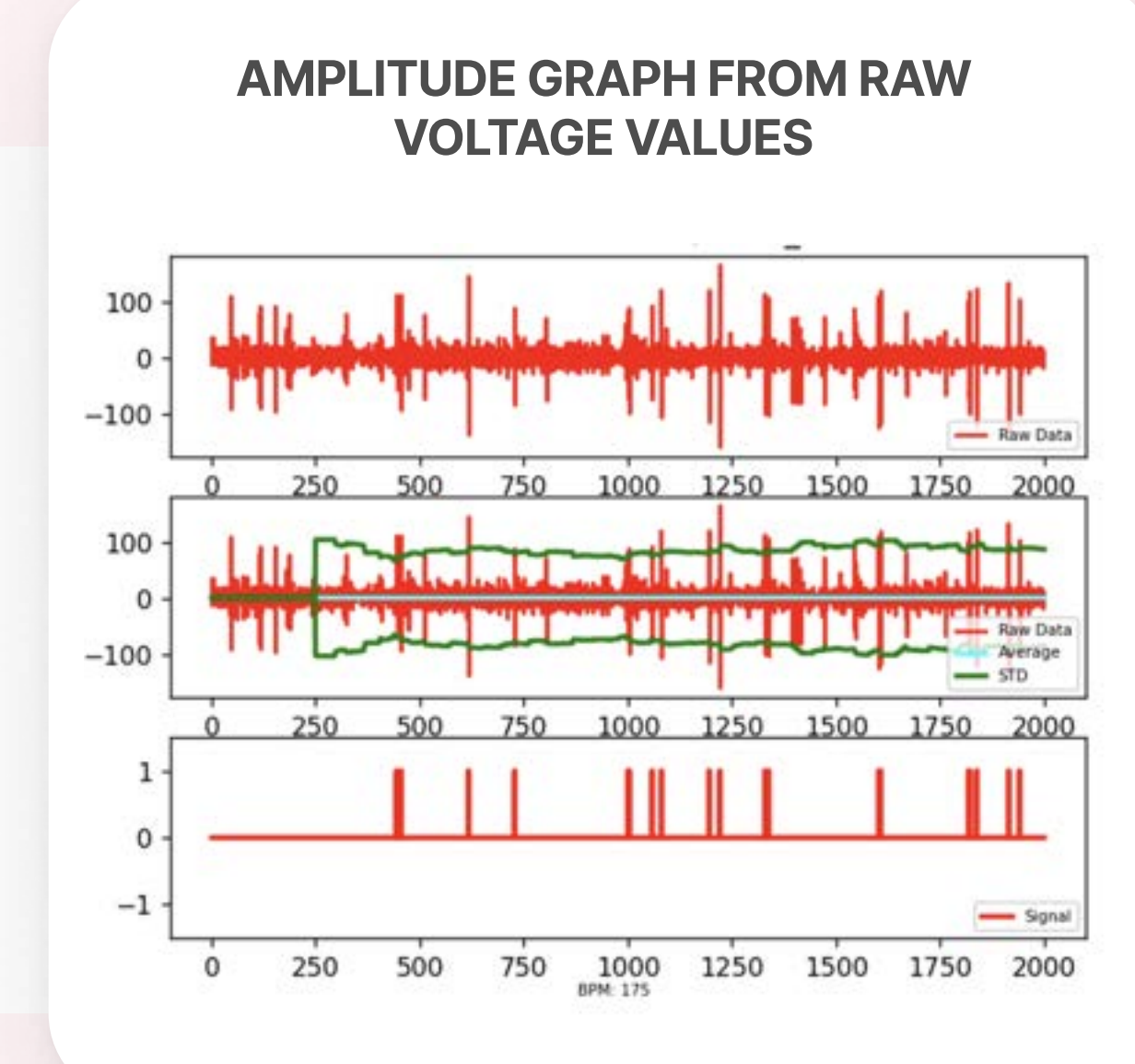
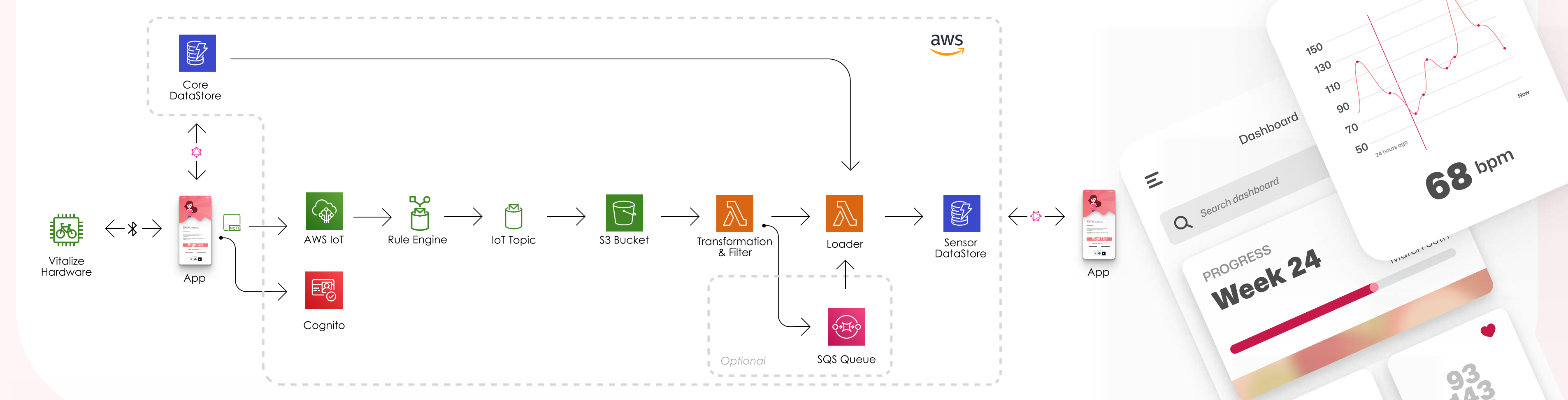
SPECIFICATIONS

SOFTWARE ARCHITECTURE



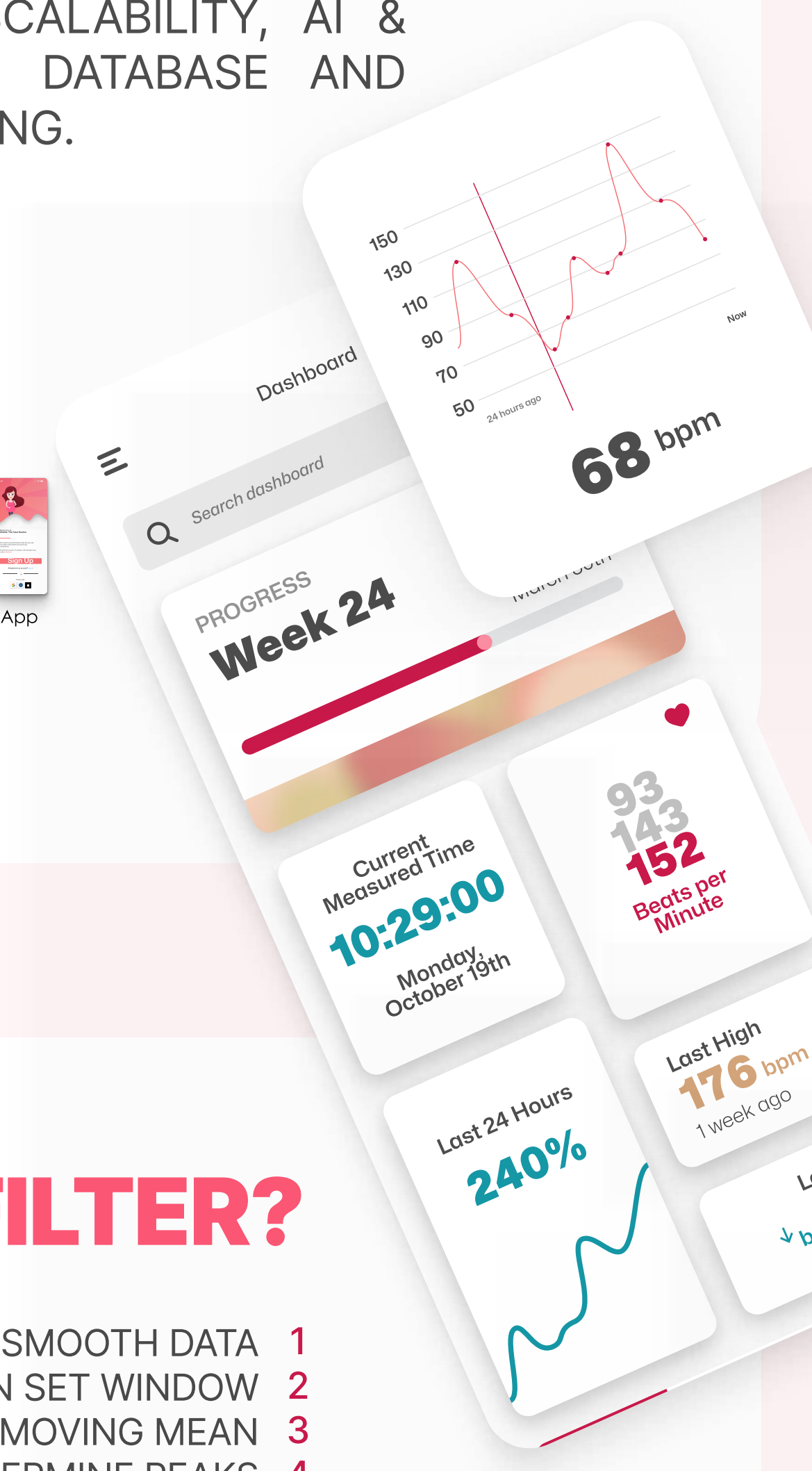
WITHIN THE CAPSTONE PERIOD, THE VITALIZE TEAM DEVELOPED A FULL-STACK APPLICATION INCLUSIVE OF A REACT NATIVE MOBILE APP, CLOUD ARCHITECTURE ON AWS INCLUDING S3, LAMBDA FUNCTIONS, AND DYNAMODB, AND FINALLY ESTABLISHED A BLE INTEGRATION WITH ANDROID.

WHY AMAZON WEB SERVICES? → EXCEEDS IN: HIGH CONNECTIVITY, READILY AVAILABLE SOFTWARE DEVELOPMENT KITS, SCALABILITY, AI & MACHINE LEARNING CAPABILITIES, DATABASE AND CLOUD COMPUTING, DEVICE HANDLING.



HOW DO WE FILTER?

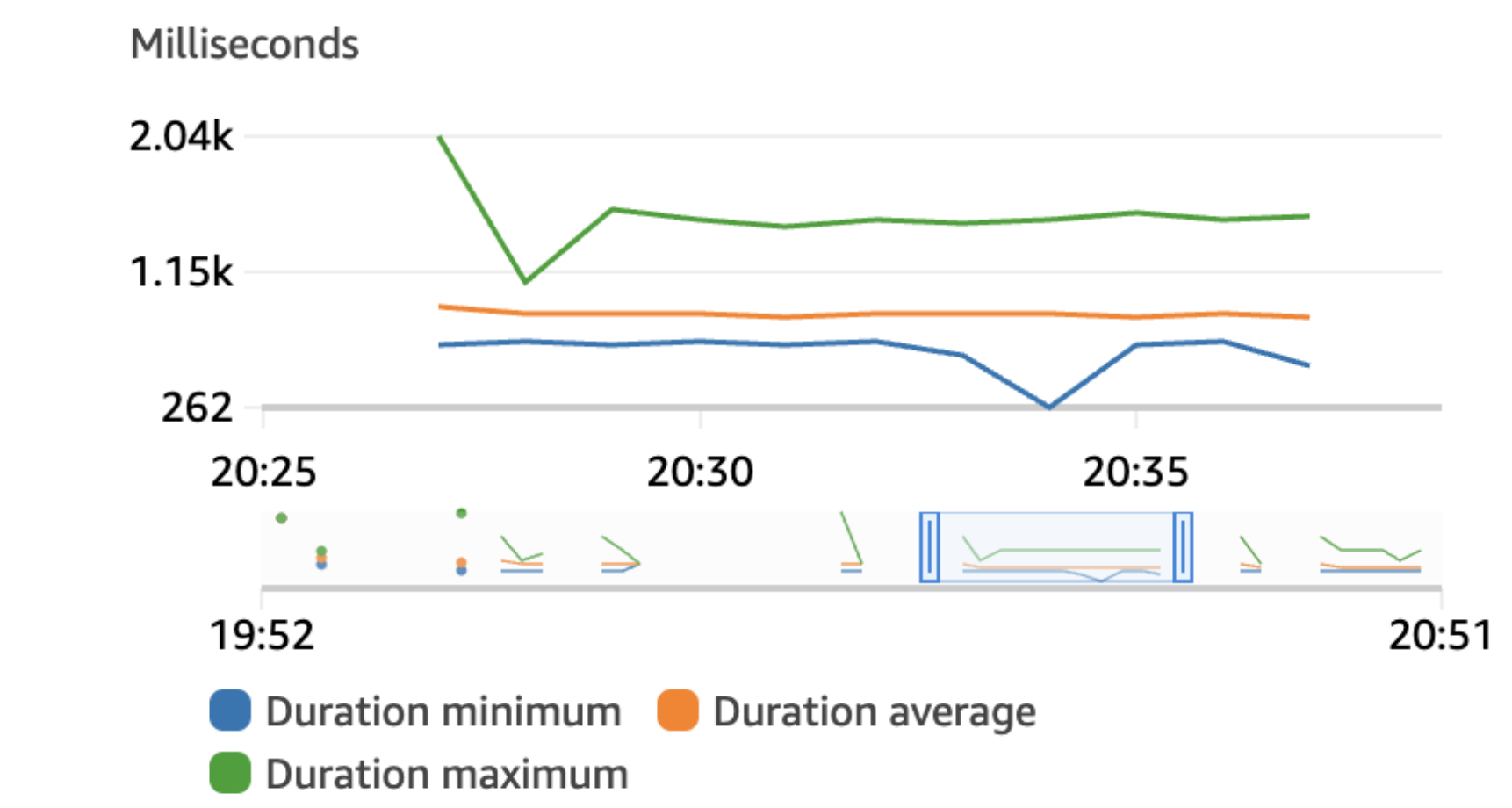
- APPLY A TRANSFORMATION FUNCTION TO SMOOTH DATA
- CALCULATE MOVING MEAN BASED ON SET WINDOW
- CALCULATE STANDARD DEVIATION ON MOVING MEAN
- DETERMINE PEAKS
- AGGREGATE AND COMPUTE BPM



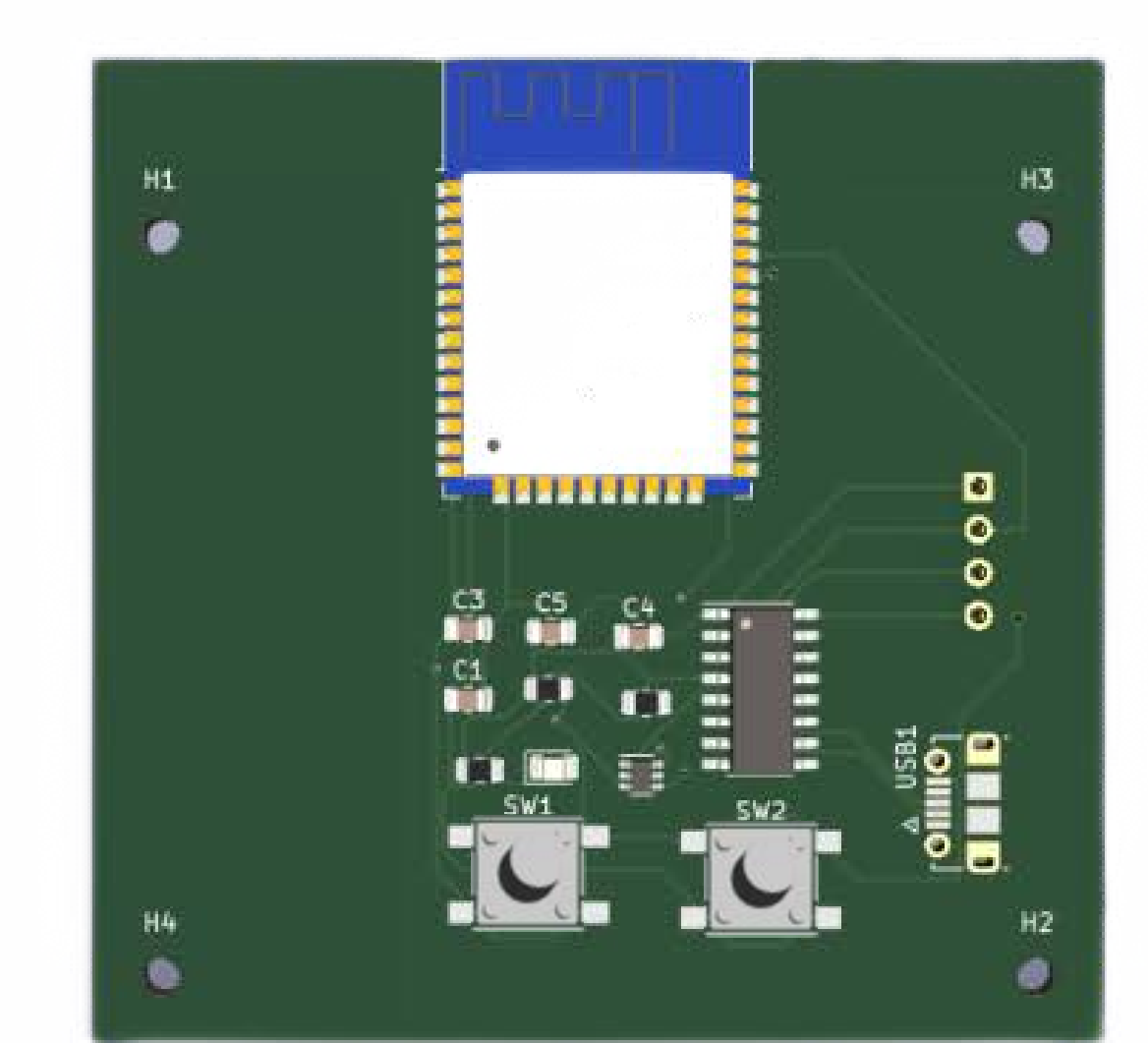
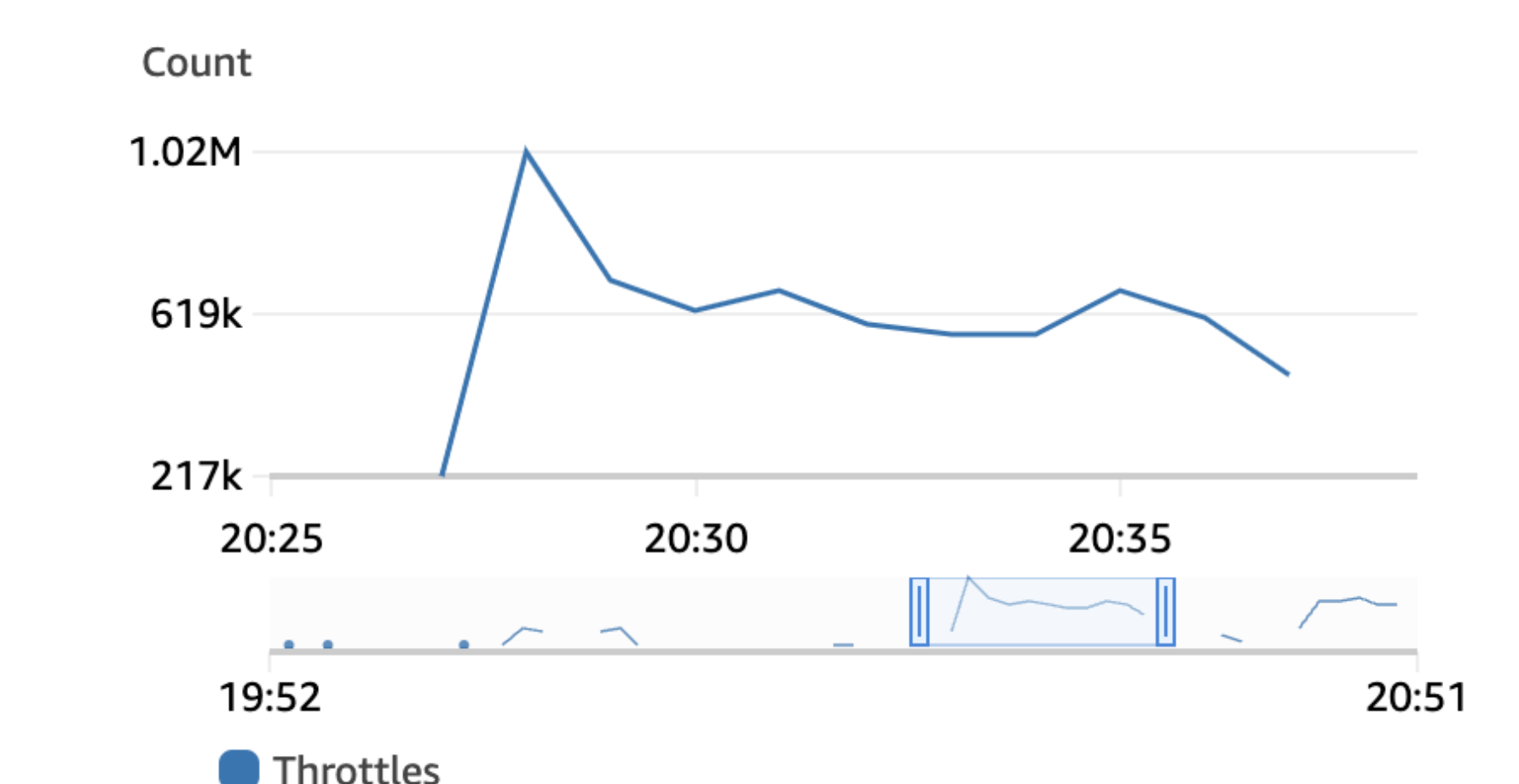
SOFTWARE LOAD TESTING

ASSESSING LAMBDA FUNCTION PERFORMANCE THROUGH ARTILLERY & CLOUD WATCH. SIMULATING 1K USERS OVER A 3 MINUTE INTERVAL REQUESTING BPM DATA.

TIME SPENT PROCESSING DATA



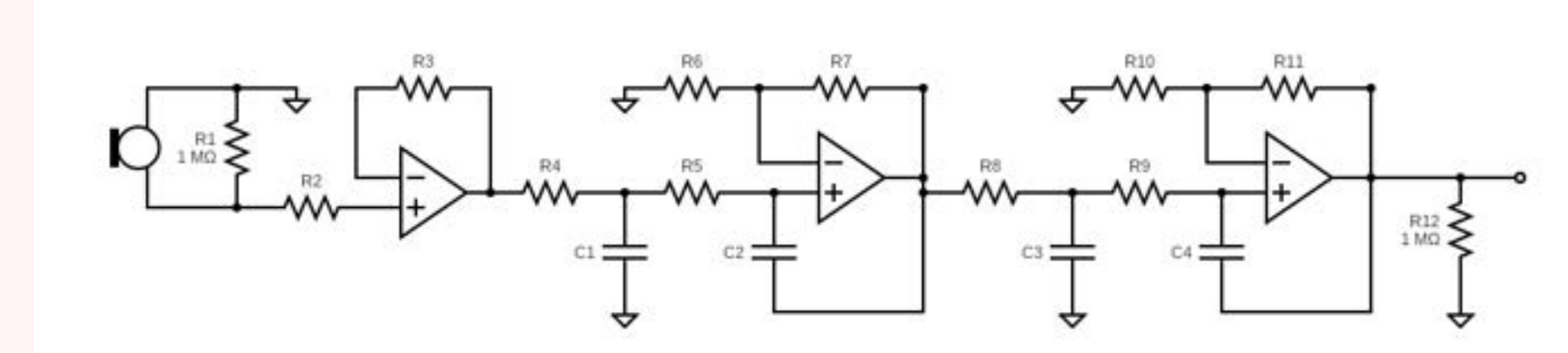
THROTTLES



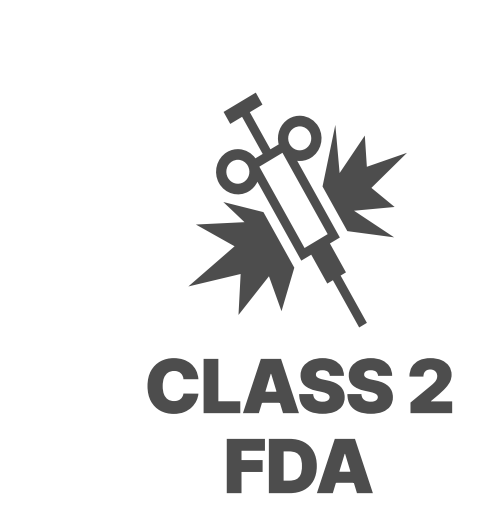
BLE BOARD

FILTERING CIRCUIT

THE FILTER DESIGN CONSISTED OF AN AMPLIFICATION STAGE, FOLLOWED BY A 4TH ORDER ACTIVE LOW PASS-FILTER USING A TRADITIONAL SALLLEN-KEY LAYOUT (ACCOMPLISHED BY CASCADING TWO 2ND ORDER FILTERS IN SERIES).



HEALTH & SAFETY FUTURE CONSIDERATIONS



[1] WWW.COMMONWEALTHFUND.ORG - [2] WHO PUBLICATIONS - [5] MHEALTH