ELECOMP CAPSTONE

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THINK BIG WE DO℠

Digital Companion for Obesity

Novo Nordisk's Foray Into Portable Health Technology

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Technical Directors

John Canevari
Associate Director Digital Transformation & Innovation

Fola Olabisi
IT Architect Technology Innovation & Architecture

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Associate Director IT Business Applications ML/AI

Karthik Kumar
Project Manager – Digital Transformation & Innovation

Shabana Motlani
Associate Director of Scientific Analytics

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ELECOMP Capstone Designers

Afolabi Abayomi
Computer Engineer

Justin Watkins
Electrical Engineer
Computer Engineer
Computer Science
Applied Math

Dayla Olivo
Electrical Engineer

Connor Vincent
Electrical Engineer

Yashaswini Mandalam
Computer Engineer

Company Overview

- Founded 1923 Denmark
- Insulin Production
- Research and Development
- Chronic Illnesses
  - Obesity
  - Diabetes
  - Alzheimer's
  - Sickle Cell Disease

Project Motivation

- Worldwide Obesity Epidemic
  - US Obesity Rate: 41.9 %
  - Global Obesity Rate: 39 %
- Few Treatment tools
- Depression and Social Isolation
- Comorbidities

Anticipated Best Outcomes (ABOs)

- iOS Application
- Compact Smartwatch with a Custom Sensor Array
- Machine Learning Models
- Personalized and Seamless Engagement

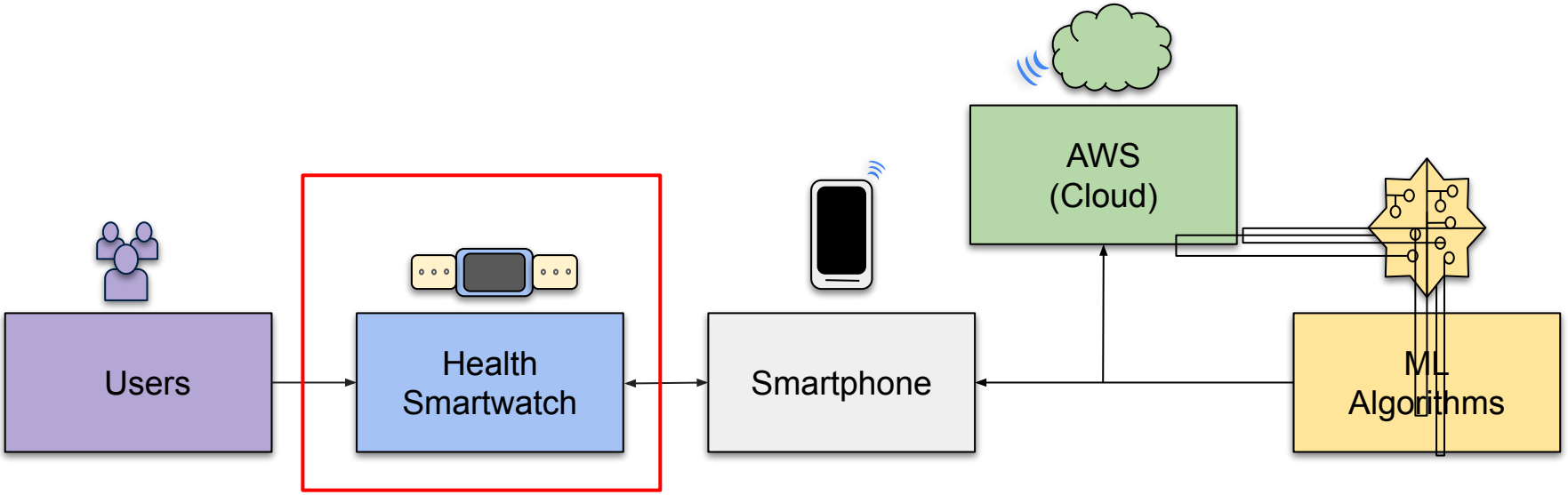
ABO Accomplished

- ABO Achieved.
- Personalized disease-state related outputs generated from digital companion
  - Custom hardware with health sensor array
  - IOS application to engage with user
  - Engagement personalized towards user
  - Utilize machine learning models to actively adapt

Technical Accomplishments

- Established the Semantic Feature Extraction Library (SFEL) Initial Models
- Data Pipeline Begun
- Frontend Design and Implementation
- Health Sensor Research and Testing
- Adaptable Testing Hardware
- Foundational Training for Large Life Contextual Description Model (LLCDM)

Project Block Diagram



Connor

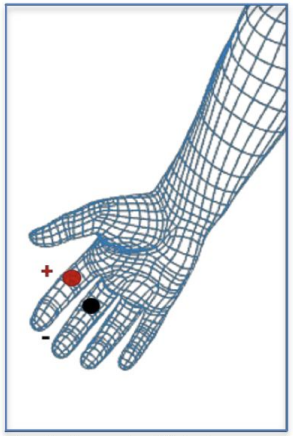
Designer 1: Connor Vincent

- Prototype Hardware Design
  - Board Schematics
  - PCB Layout
- Product Assembly
- Sensor Research and Selection
- Sensor Testing

Connor

Biometric Sensors

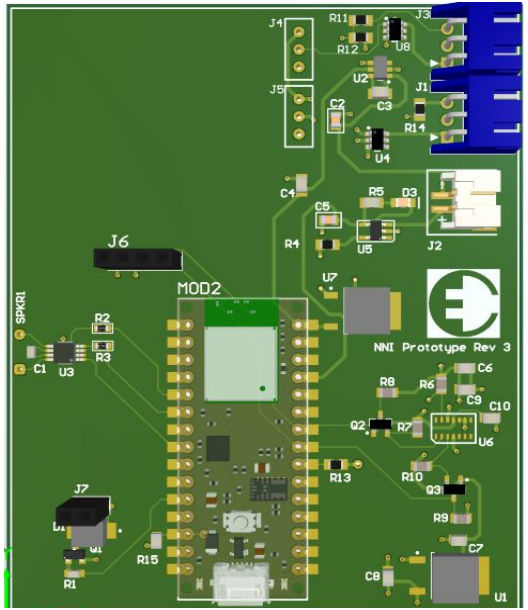
- Heart Rate Sensor
- Heart Rate Variability
- EMG - Electromyography
- ECG - Electrocardiogram
- EDA - Electrodermal Activity
- Temperature Sensor



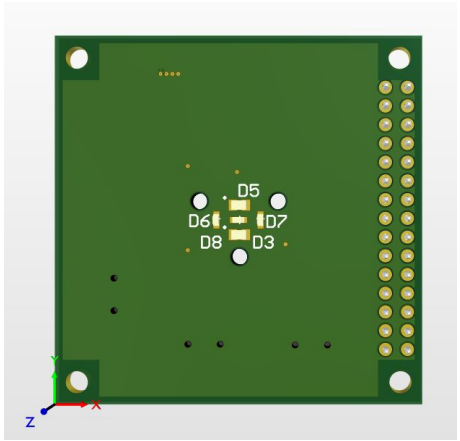
EDA Placement

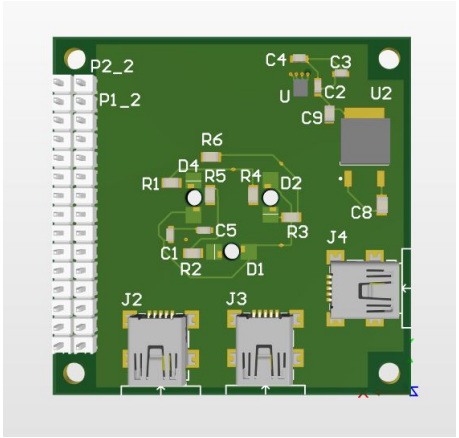
ECG Sensor Leads

Prototype Revisions



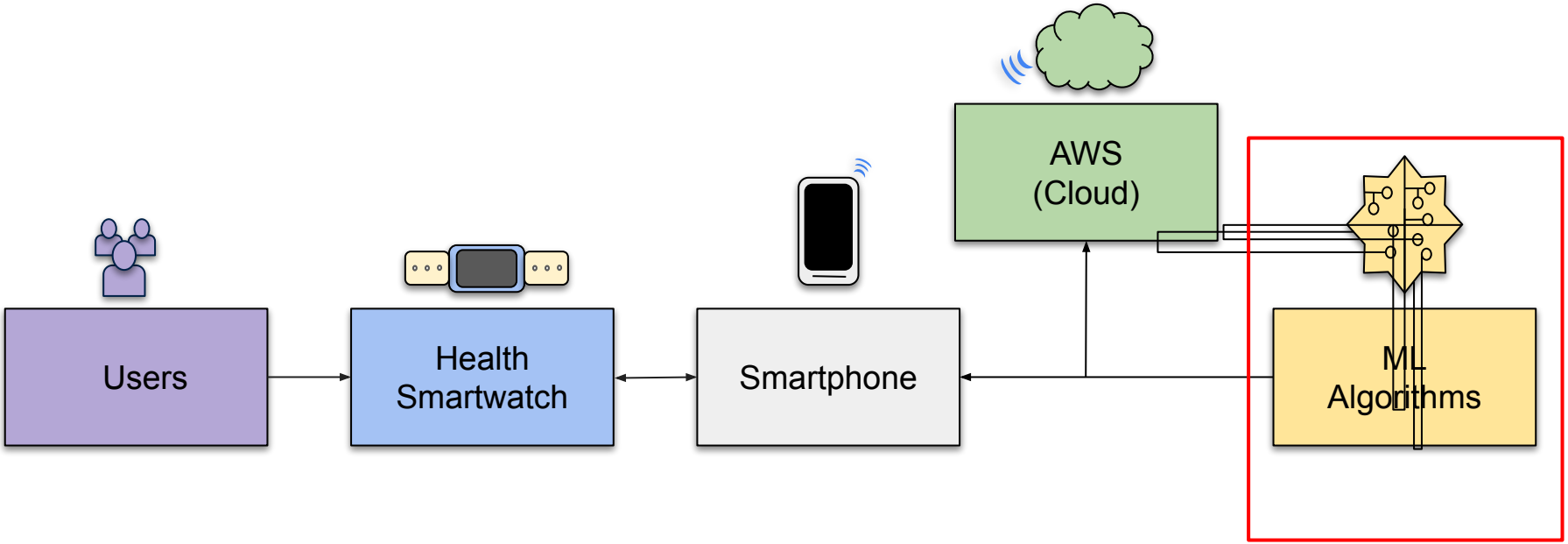
Revision 3





Revision 4

Project Block Diagram

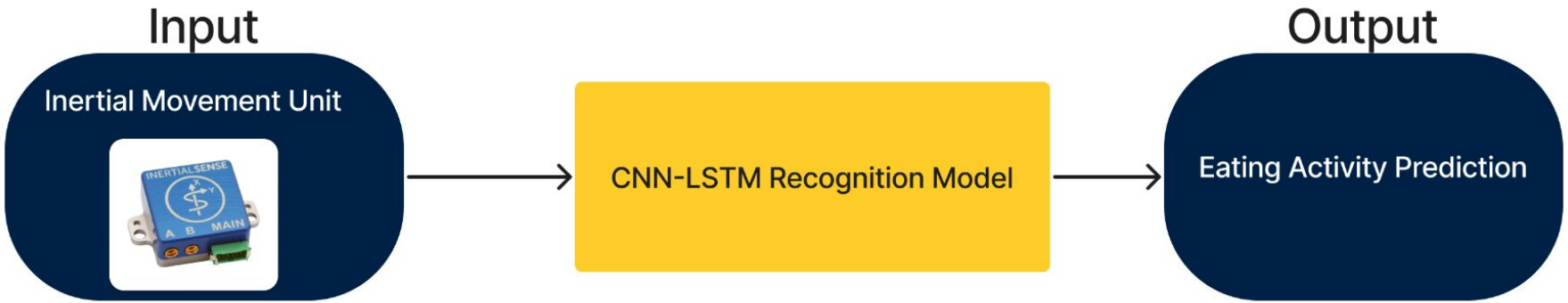


Yash

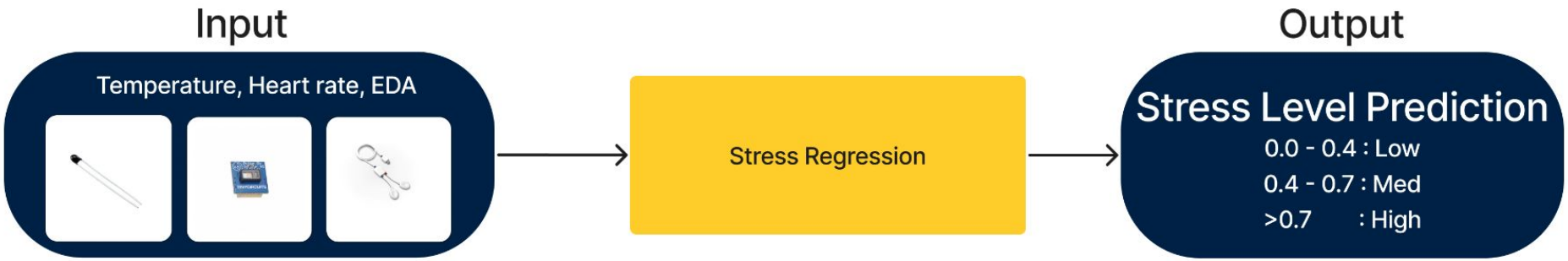
Designer 2: Yashaswini Mandalam

- Models
  - Activity Recognition
  - Stress Regression
  - Emotion Recognition
- Embedded Systems

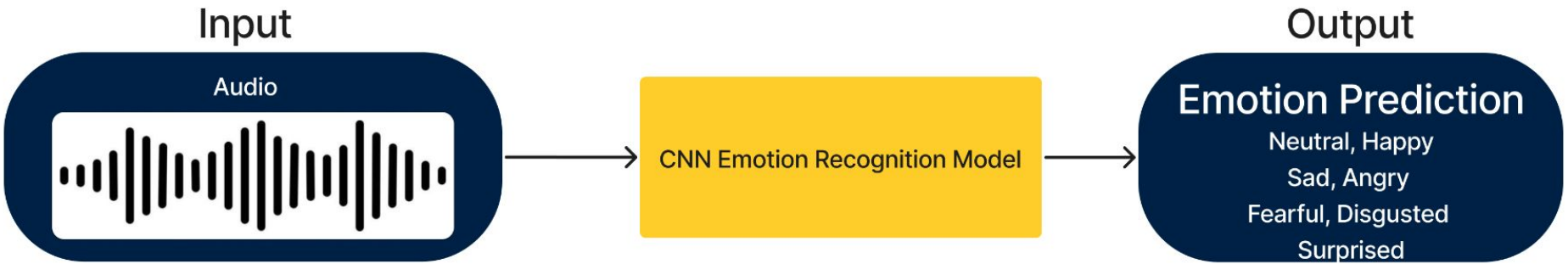
Activity Recognition

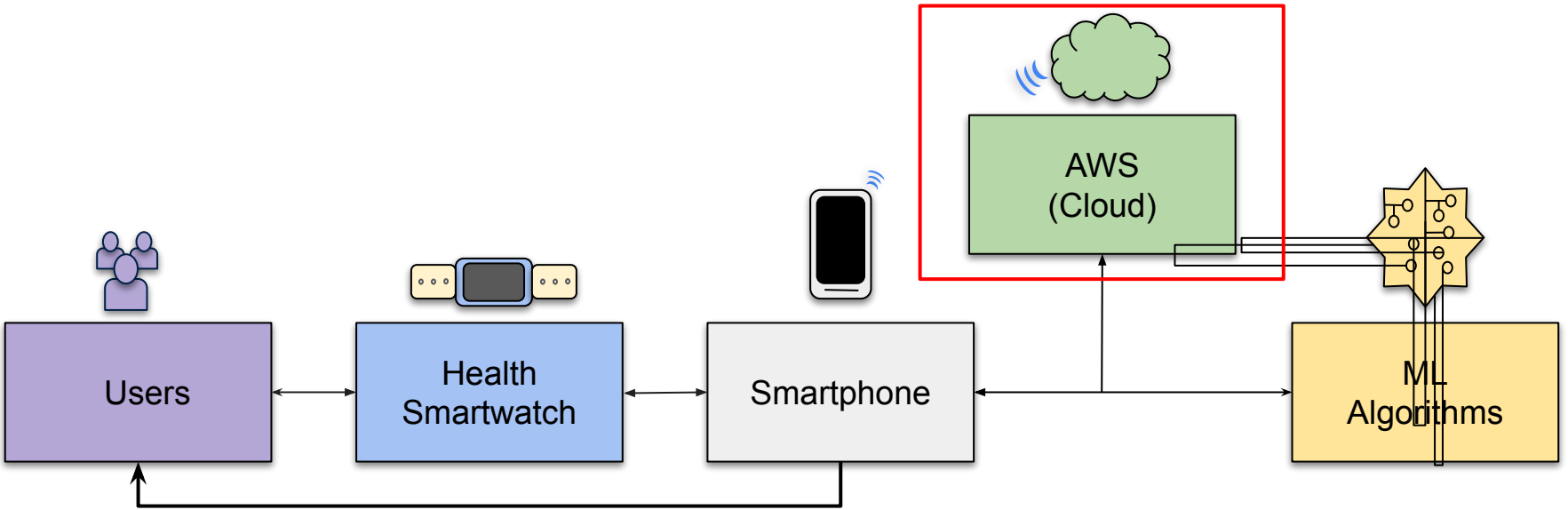


Stress Regression



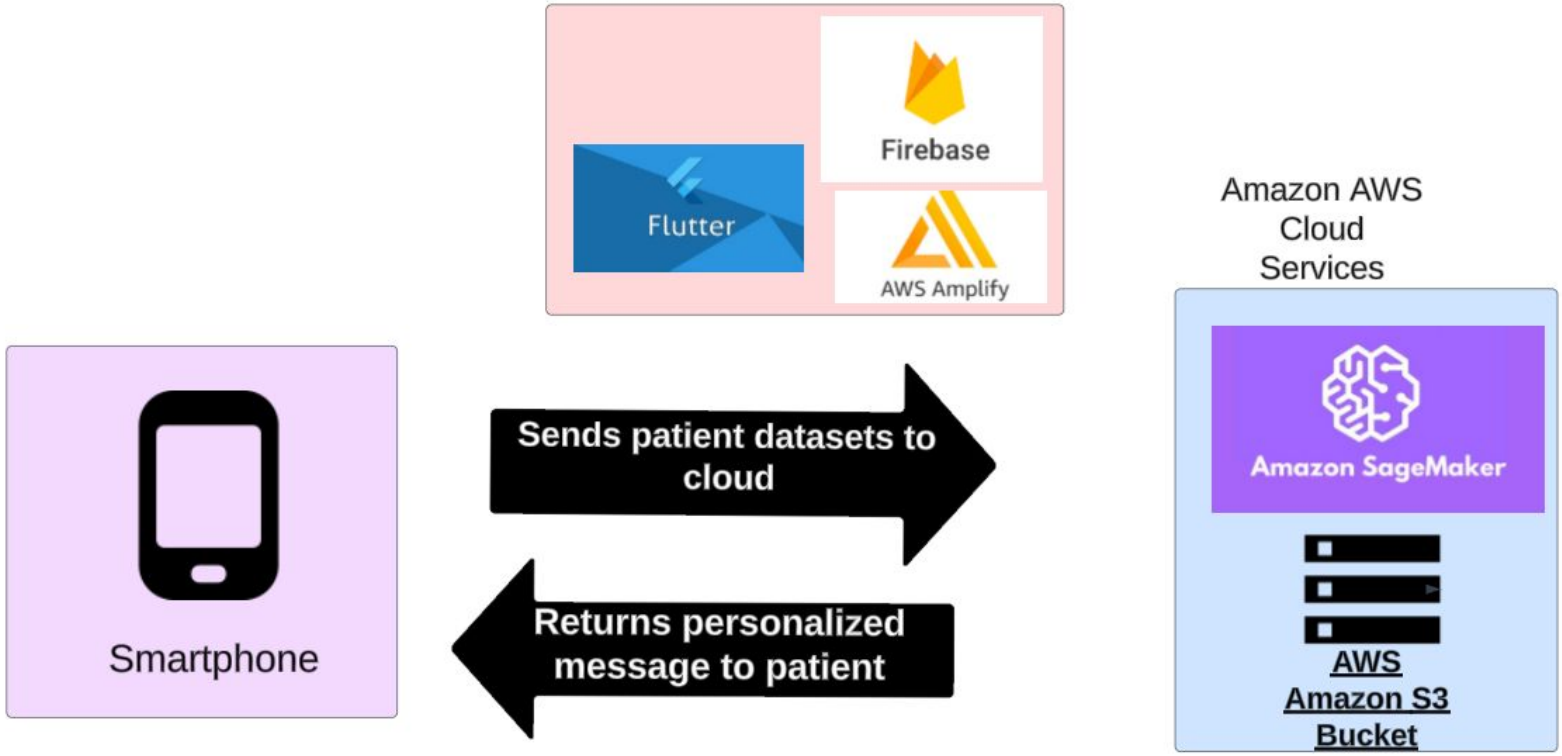
Emotion Recognition



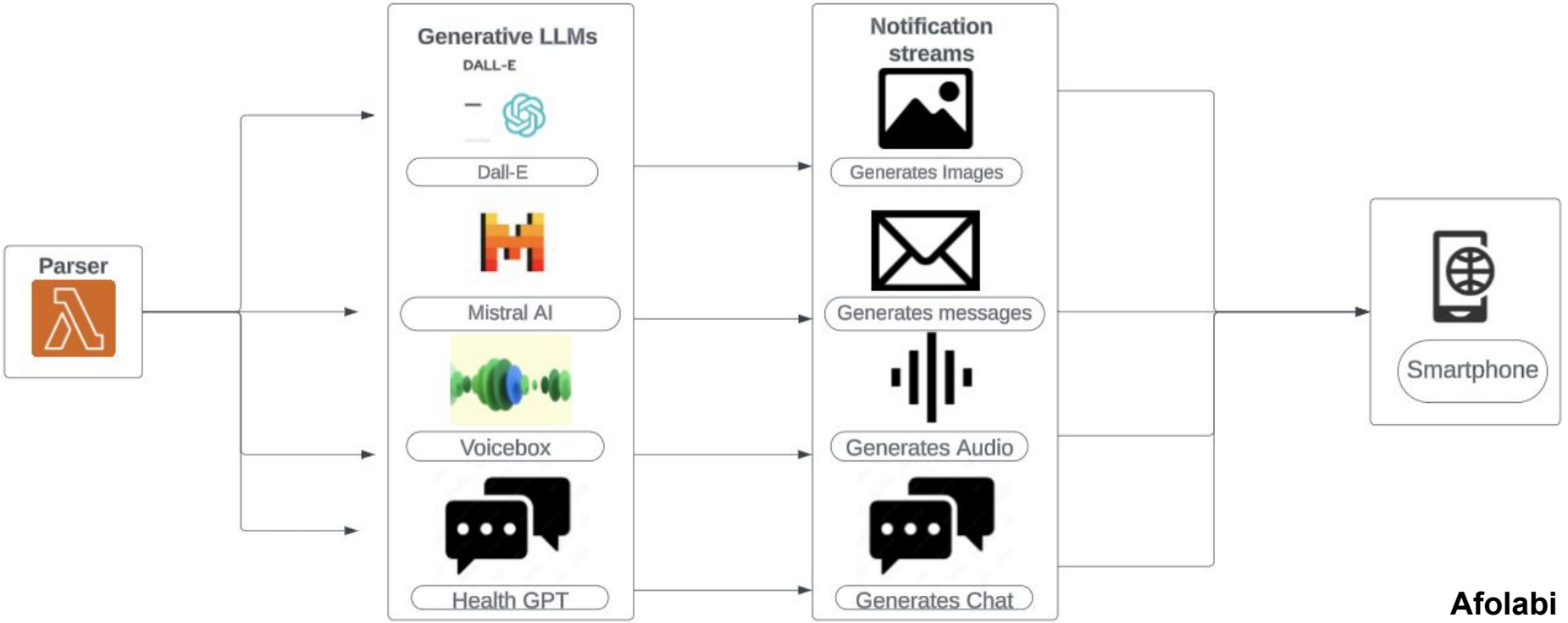

AWS
(Cloud)
Users
Health
Smartwatch
Smartphone
ML
Algorithms

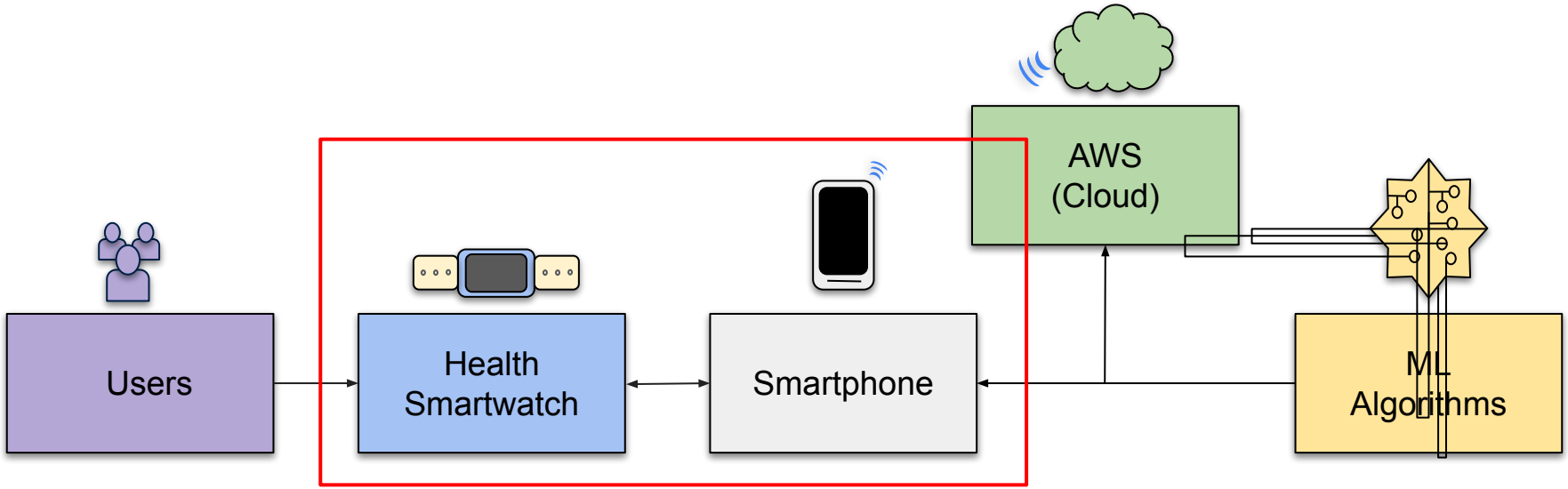
Designer 3: Afolabi Abayomi

- AWS Cloud storage deployment
- Flutter fire deployment
- Video datasets capture.
- AWS Backend


Flutter
Firebase
AWS Amplify
Amazon AWS Cloud Services
Amazon SageMaker
AWS Amazon S3 Bucket
Smartphone
Sends patient datasets to cloud
Returns personalized message to patient

Generative Models for Platform Engagement (GMPE)

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Designer 4: Dayla Olivo

Hardware

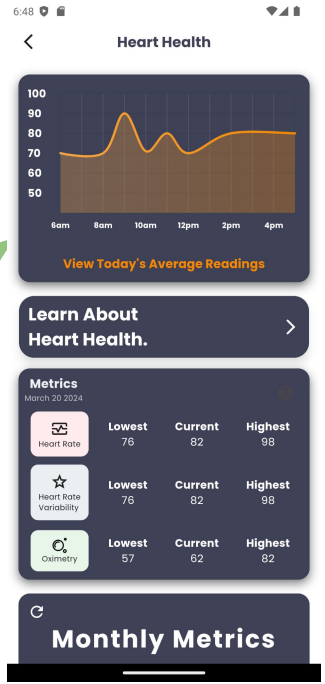
- Schematic Reviews
- Layout Design
  - Revs 1-3.

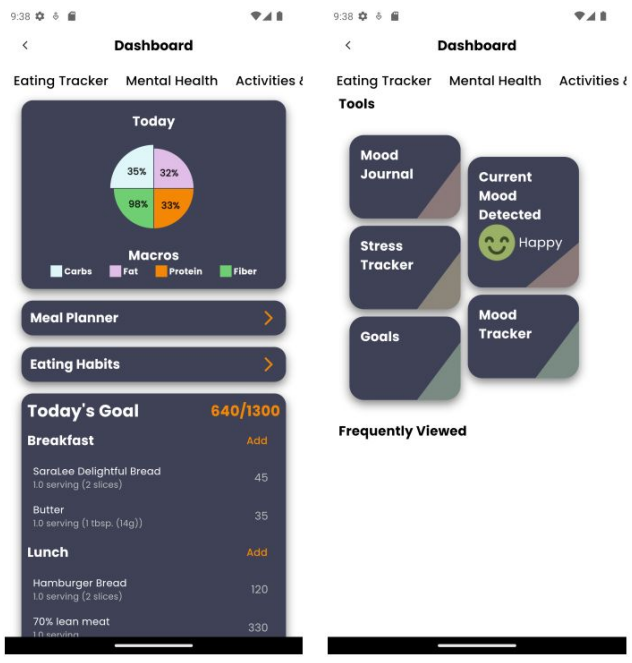
IOS App

- Frontend Design and Implementation

UI: Dashboard

Heart Rate Graph

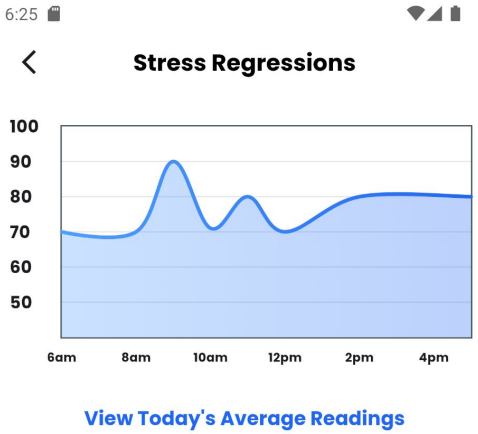




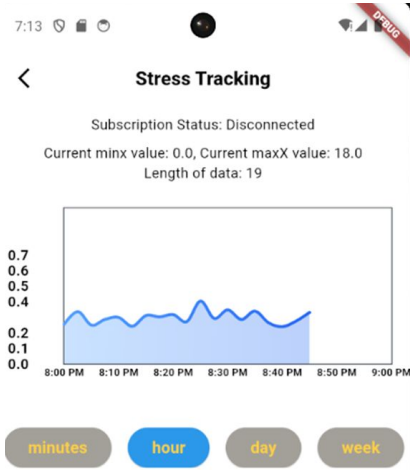
Picture of Application Dashboard

Dayla

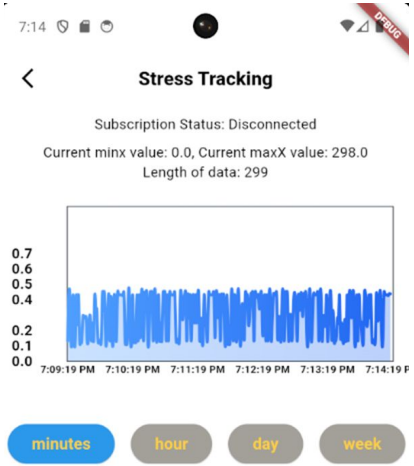
UI: Real-Time Data Displayed



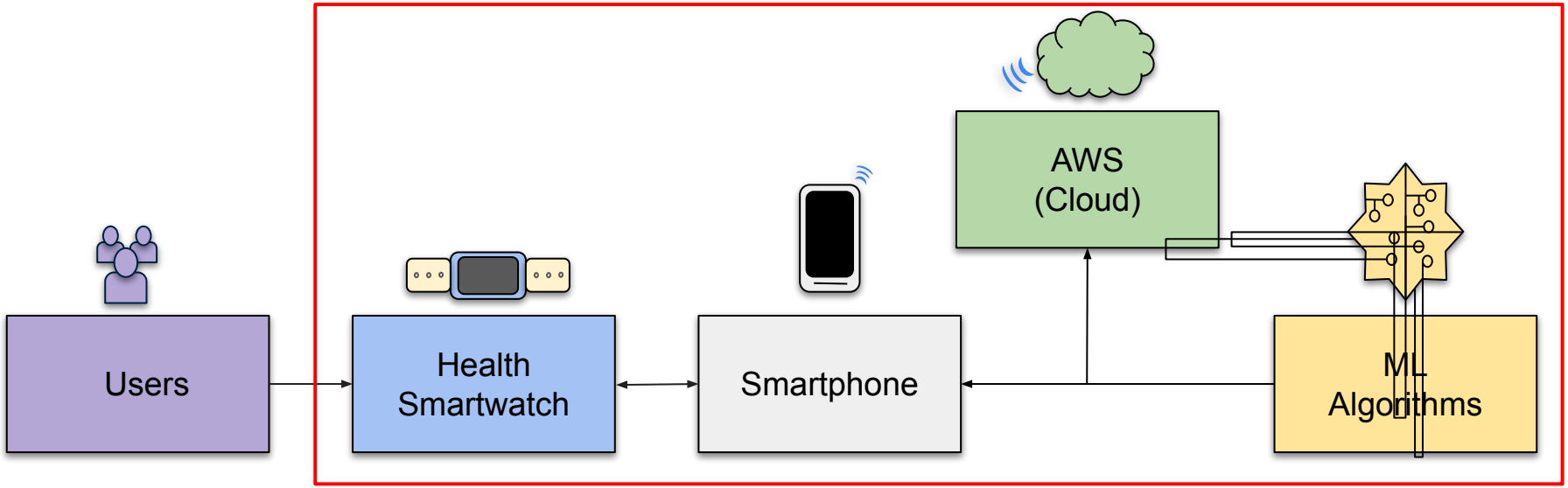
Mockup Data



Real Data



In Intervals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Designer 5: Justin Watkins

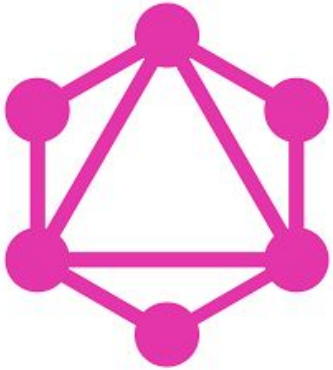
- AWS Backend
- Flutter Application Backend
- Embedded Systems
- Prototype Implementation, Sensor Experimentation, Sensor Data Processing
- Large Life Contextual Description Model Training

Justin

Backend and Bluetooth

flutter_reactive_ble

flutter_riverpod



GraphQL API

AWS Amplify

Kinesis Data Stream

Lambda Functions

Sagemaker Endpoints

Justin

The Embedded System

ARDUINO

Extensive Sensor Libraries Utilized

Quick Prototyping and Ease of Integration

freeRTOS

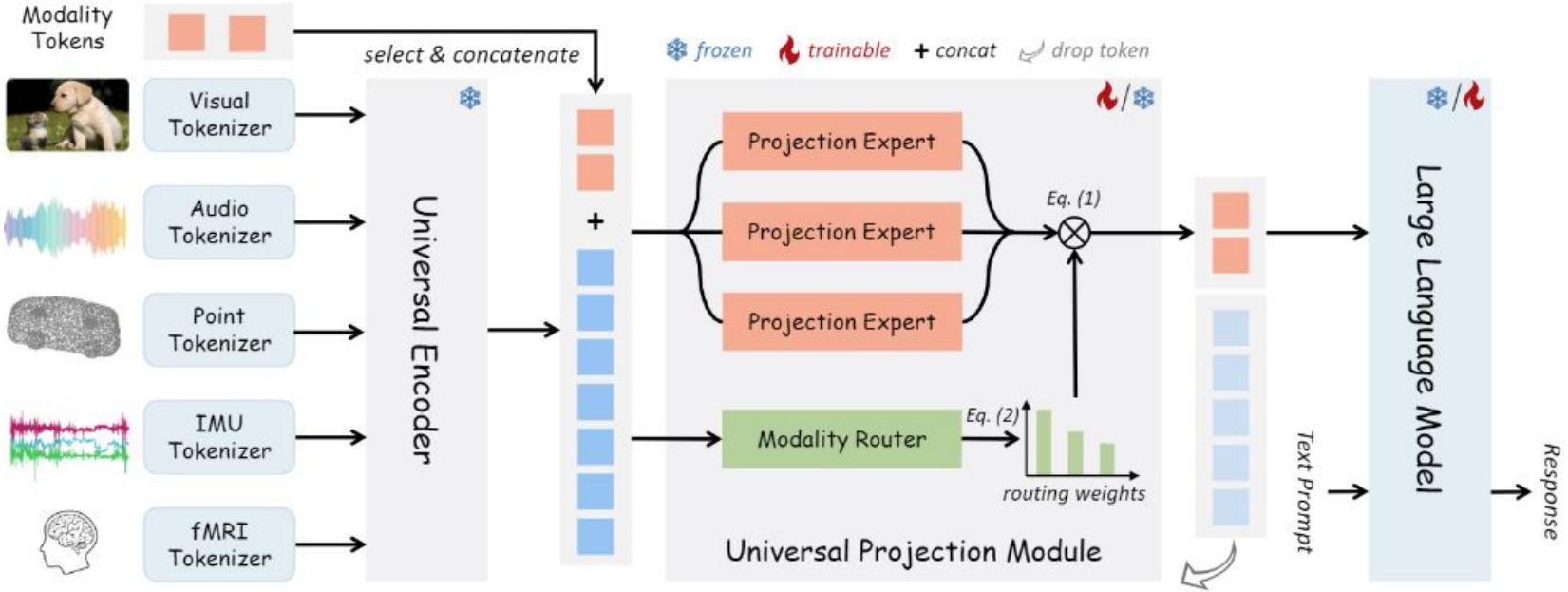
Multi-threading Support

Direct Integration with ESP32-S3

Extensive Libraries and Firmware to Utilize for User Interaction

Justin

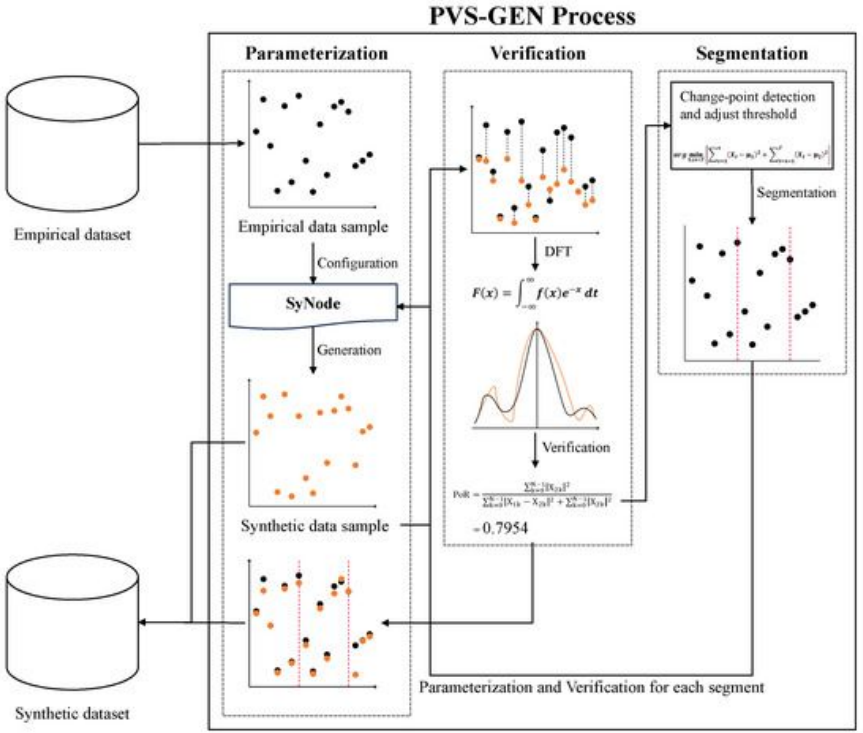
OneLLM-Multimodal Large Language Model



Justin

Dataset Generation

- PVS-GEN Methodology: Automates synthetic data generation with minimal human input.
- Performance Advantage: Surpasses existing methods with up to 37.1% better data similarity.
- Scalable Automation: Efficiently handles diverse time-series data types.



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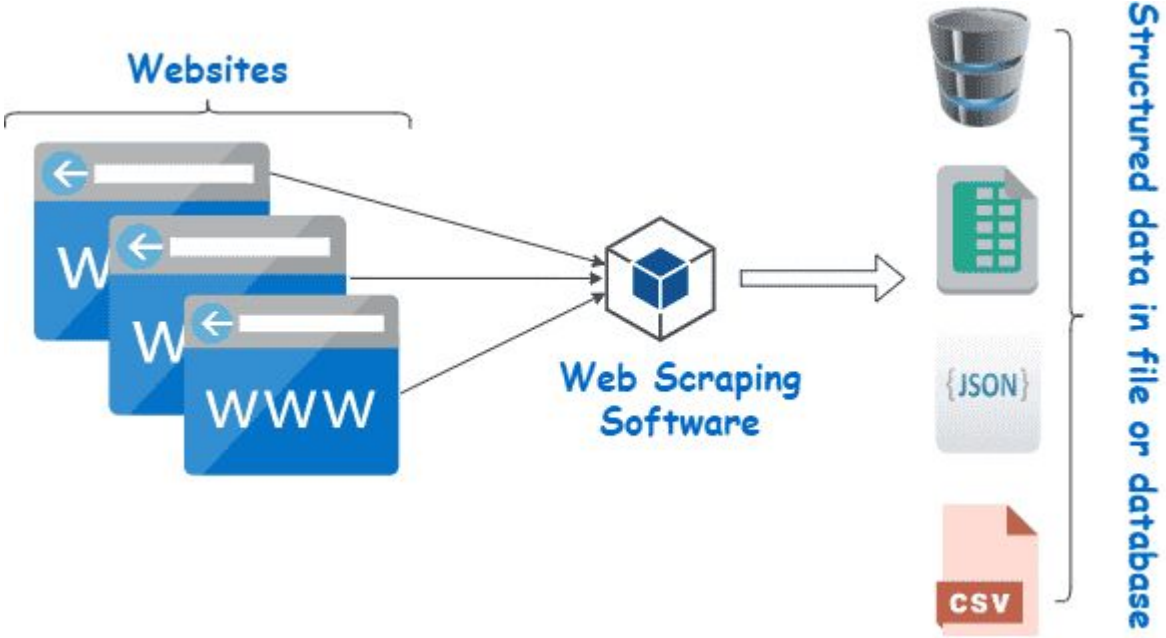
Dataset Generation



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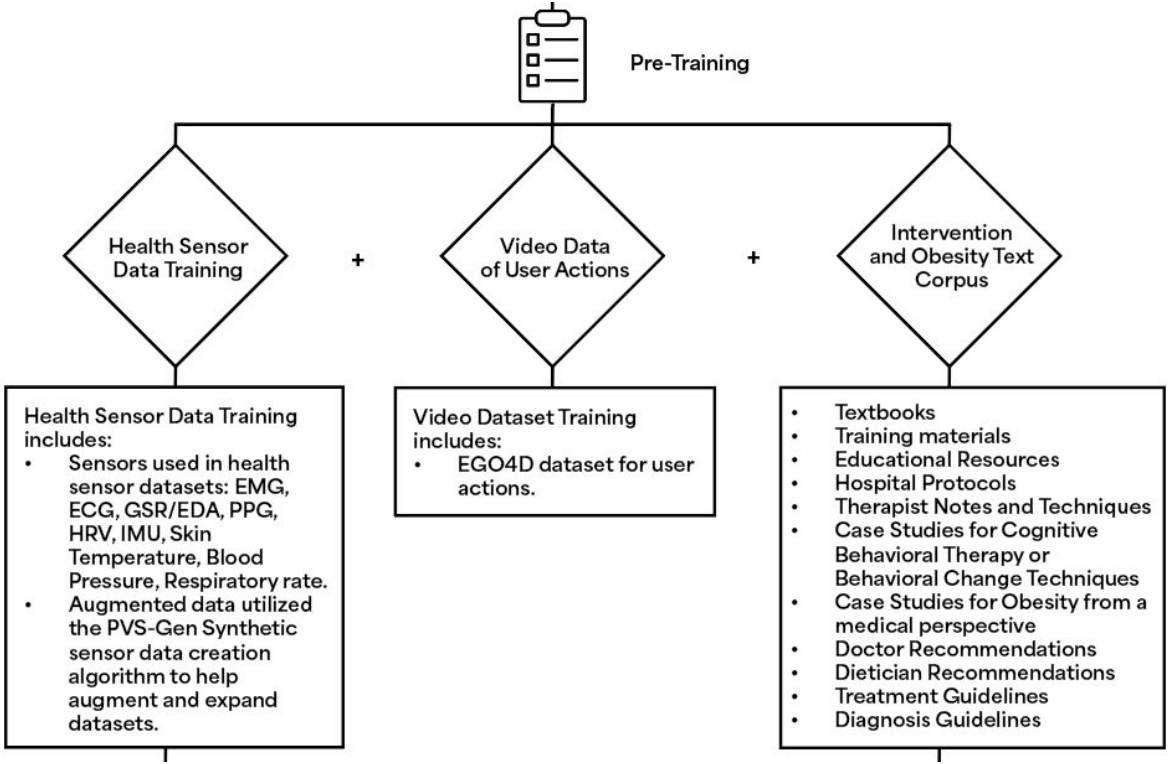
Training Sequence



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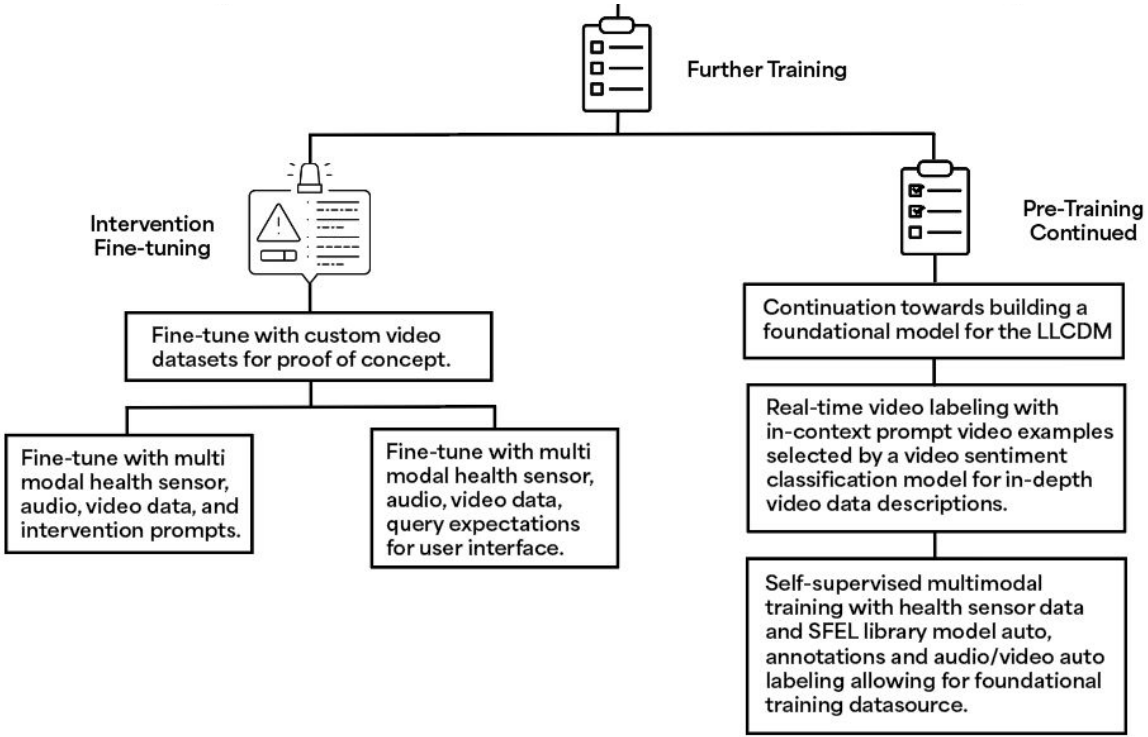
Future Training Sequence



Justin

Project Future

- Expansion and Refinement of Hardware
- Expansion of the SFEL
- Foundational Training Continued for the LLCDM
- Optimization of Backend
- Application Expansion
- Further Fine-tuning for the LLCDM

Justin

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Acknowledgement

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ELECOMP Capstone Director:

Dr. Harish Sunak