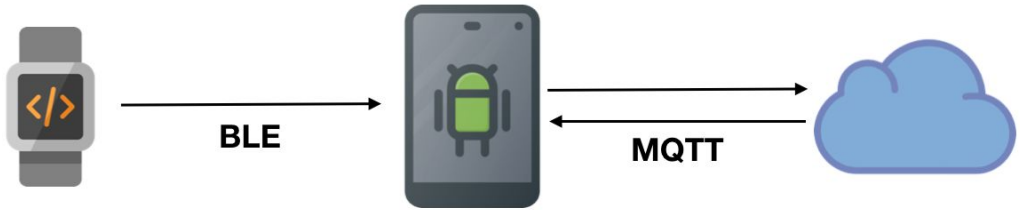
CS3237 Final Assessment

Group 9

Objective

- Wearable IoT device
- Able to detect cardiac arrest
- Able to monitor heart rate

Overview of IoT Healthcare System



Edge Device

- Collect accelerometer and pulse oximeter data
- Transmit sensor data to gateway

Gateway

- FFT for signal processing and heart rate calculation
- Monitor vitals for instant action
- Transmit sensor data to cloud
- Display output of cloud analysis

Cloud

- CNN to identify physical stress
- MLP to identify psychological stress

What have we achieved

- Designed a wearable IoT device
- Send heart rate data to gateway
- Instant action upon detecting cardiac arrest
- Forward heart rate data to cloud
- Detect psychological stress

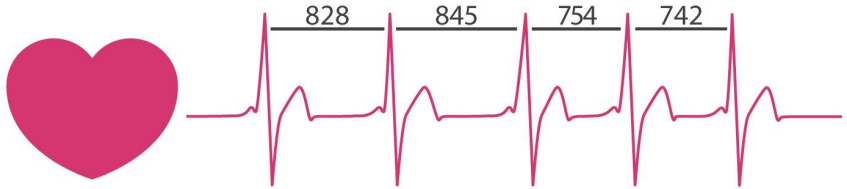
Techniques & Implementations

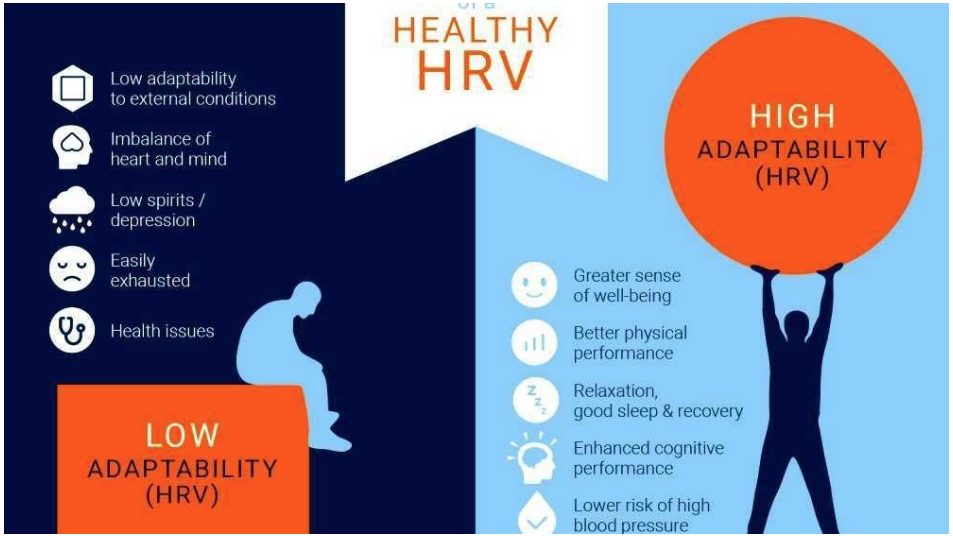
- Communication
  - Bluetooth Low Energy (BLE) to transmit sensors' data from edge device to gateway
  - Message Queuing Telemetry Transport (MQTT) to transmit sensors' data from gateway to the cloud
- Software Development
  - Android application as gateway platform to monitor vitals (for instant action) and acts as a communication bridge between edge device and cloud platform
- Signal Processing
  - Raw photoplethysmogram (PPG) signal data cleaned for further analysis
  - Fast Fourier Transform (FFT) algorithm employed at gateway to compute heart rate
  - Heart Rate Variability (HRV) analysis performed at the cloud to analyse psychological stress

Techniques & Implementations

- Machine Learning
  - Human Activity Recognition (HAR) performed at the cloud with Convolutional Neural Network (CNN) to identify physical stress
  - Transfer learning employed to develop pre-trained Multilayer Perceptron (MLP) to identify psychological stress
- Miscellaneous
  - 3D-printed wearable case created for the edge device
  - Power management techniques implemented on the edge device

Predicting Psychological Stress using HRV





Experimental Evaluation Results

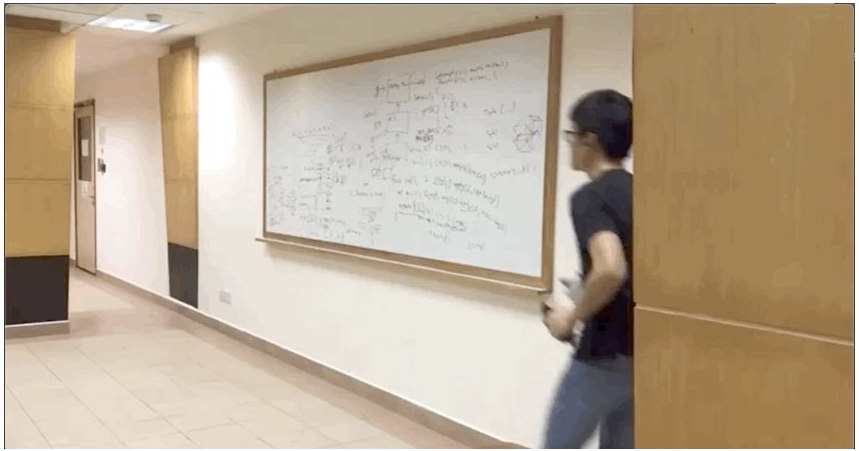
Able to use FFT to calculate heart rate at gateway to detect cardiac arrest for instant action

Able to classify when user is idle, running or jumping

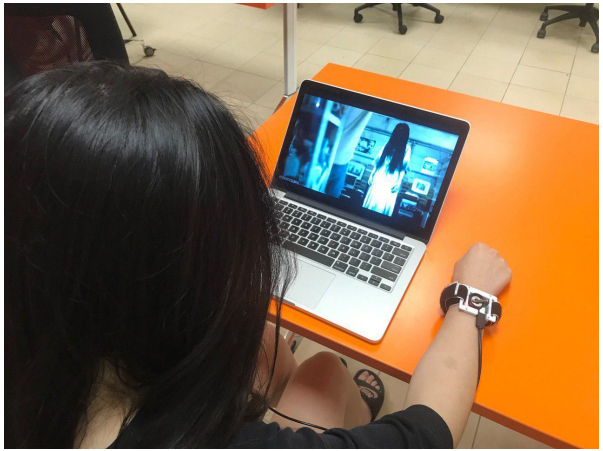
Able to classify normal heart rate and heart rate under psychological stress

Challenges Faced - Collecting Test Data

- Jumping and Running Data



Stress Data



Challenges Faced

- Lack of PPG training data online
- Difficult to implement FFT on edge device due to lack of computational power