Medicallity: A Wearable Sensor for the Elderly (YJ1c-16)

LAU Ka Kiu Ives, LEE Yan Ming, WONG Pak Hin

YUAN, Jie George

Introduction

There are 4 main vital signs, of which three are heart rate, body temperature and blood pressure. These signs can be used to detect or monitor medical problems. Monitoring vitals would help the elderly person and their family manage the elderly person’s health at home, which the elderly person may find more comfortable and convenient than travelling to a clinic. In light of this, health monitoring products are currently available for personal use. However, these products have 2 main shortcomings:

1) They monitor at most 2 vital signs, providing a limited amount of information to the user
2) Blood pressure measurement products make use of an inflatable cuff which can cause pain if worn incorrectly.

Given these shortcomings, this project proposes a wearable sensor that will be incorporated into a long-sleeved shirt for the elderly to wear. This sensor will measure heart rate, blood pressure and body and will adopt the cuff-less and less painful blood pressure measurement proposed by [1].

Objectives

We will design a wearable sensor to accurately monitor three vital signs: blood pressure, heart rate and body temperature, to provide more information about the elderly user’s physiological state without leaving his or her home. We will also increase the accuracy and precision of blood pressure measurement through analysis of PPG and ECG signals and the usage of a new sensor placement combination.

System Block Diagram

We used 3 sensors:
- Easy Pulse V1.1 (PPG)
- AD8232 (ECG)
- TMP 102 (Body Temperature)

These sensors will be interfaced with the CC2541 which will transmit the data to an Android App. A PCB will be designed to combine all components.

Methodology

1) Interface AD8232 (left) and Easy Pulse V1.1 (right) with the CC2541 through ADC channels
2) Interface of the TMP 102 with the CC2541 through an I2C channel
3) The MCU CC2541 is connected to a BLE App through adding an application layer onto OSAL’s existing BLE layers
4) A task with 3 periodic events was created in OSAL. Data from the above three sensors is put into characteristics whose values will be periodically transmitted by the MCU to an app.
5) A multi-level board is created with separated ground and power planes to reduce noise
6) The App was enabled to automatically connect and read data of the 3 characteristics from the CC2541 in synchronization

Results

All 3 sensors were successfully interfaced with the CC2541 and the Android App is functional. After collecting much data received by the App, blood pressure equations for both systolic and diastolic blood pressure were developed and showed a deviation of 8.44% which is more accurate than existing algorithms. Two PCBs were created. One of which cannot output a PPG waveform while the other is undergoing the soldering and debugging process. Work is ongoing to make the final product smaller and more wearable.

Conclusions

The main objective of this project was to design a wearable sensor, incorporated into a long-sleeved shirt that could accurately monitor three vital signs – blood pressure, heart rate and body temperature. Without a functional PCB, this product is not yet wearable, although the interfacing of the sensors and usage of OSAL proves PPG, ECG and body temperature data can be transmitted from the CC2541. Work is ongoing to make the final product smaller and more wearable. The second objective was to increase the accuracy and precision of the blood pressure algorithms developed by [1]. The deviation is 1.56% less than previously developed algorithms, demonstrating our success.

References: