School of Electronics and Computer Science

ELEC6200 MEng Group Design Project

Project Specification and Plan

GDP Number and Title: Group 12 - Soft, wearable pressure sensors for continuous wireless monitoring of blood pressure enhanced by artificial intelligence

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Project Specification:

This project aims to develop a soft, wearable pressure sensor system for continuous monitoring of blood pressure. The system will communicate wirelessly with a central device (such as a smartphone), displaying the recorded information on a simple GUI. Utilising Artificial Intelligence (AI), informed predictions about the patient's health such as early recognition of cardiovascular diseases (CVDs) as well as other insights can be made. The project is expected to produce a prototype of these combined technologies, with the potential of developing into a pre-production device as a stretch objective. The deliverables of the project have been divided into two broad phases, Phase I and Phase II, both of which follow the same overall flowchart as established in Figure 1.

1 Phase I

Phase I introduces the functional aspects of the project, laying the groundwork for further development and refinement later on. A Liquid Metal (LM) piezoresistive sensor will be fabricated on a biocompatible, stretchable, skin-like PDMS (polydimethylsiloxane) gel that detects fluctuations in arterial blood pressure as the blood vessel walls expand and contract. This corresponding oscillation in pressure against the sensor will induce a voltage based on the piezoelectric effect which is then sampled and transmitted over a wireless communications module such as WiFi or Bluetooth Low Energy (BLE), selected based on bandwidth and power consumption.

In Phase I, the device will be based on a rigid PCB, removing the design constraints of making it wearable (which will be addressed in Phase II). The System on Chip (SoC) is tasked with pre-processing of the sensor data and its transmission. Once received by the smartphone, a basic GUI application will display the recorded data as well as calculations

such as Pulse Transit Time (PTT). From here, basic testing will serve as a proof-of-concept which will inform the development of more sophisticated feature extractions, using AI. An ethics approval via ERGO is in progress for this purpose.

2 Phase II

Phase II of the project addresses the objectives surrounding making the system fully wearable and in a pre-production state. The rigid PCB system will move from a development board to a flexible PCB for adhesion to the skin as a "patch". With the system becoming fully wearable, considerations have to take place with regards to the contact effectiveness between the pressure sensor and the skin; potentially requiring a type of clamping mechanism to secure the patch to the skin, or through additional microfeatures to the surface of the PDMS sensor to increase the surface area (and thus contact region) of the sensor with the skin. Phase II will also include considerations for battery life, experimenting with the effects of BP measurement frequency and data transmission rate to achieve the "continuous" requirement. Testing on real patients will be a stretch objective for this phase of the project.

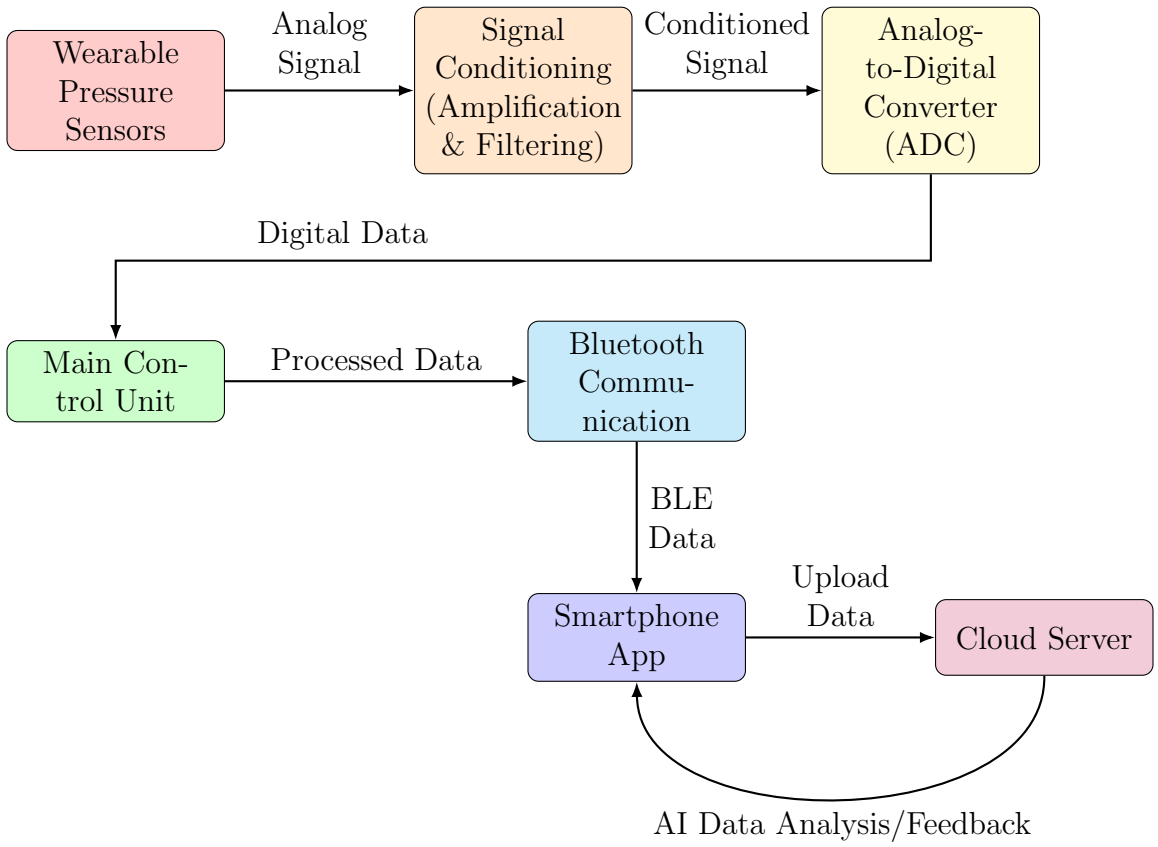

Figure 1: Flowchart for Project Specification

Wearable Blood Pressure Monitor - Project Planning

Select a column to highlight at right (current day). A legend describing the charting follows.

Current Day: 10

Plan Duration | Actual Start | % Complete | Actual (beyond plan) | % Complete (beyond plan)

PERIODS

ACTIVITY	Planned Start	Planned Duration	Actual Start	Actual Duration	Percentage Complete
Phase 0					
Kickoff Meeting	9	1	9	1	100%
Ethics Application	9	1	9	1	100%
Literature Review	7	10	7	10	50%
Phase 1					
Identify required components	9	2			0%
Review budget and order compenents	11	1			
Training for laboratory	11	3			
Liquid metal sensor fabrication	14	6			
Hard PCB sensor interface	14	6			
Basic communication / networking	17	5			
Simple interface to display data	19	5			
Data analysis to extract BP (Pulse Transit Time)	21	5			
Basic testing and revisions	14	12			
Prepare Progress Presentation					
Phase 2					
PDMS sensor fabrication	26	10			
Improved Communication / networking	26	10			
Flexible PCB	31	10			
Battery power system	36	5			
Thermal Management	36	5			
Ergonomics and aestetics	41	5			
Predictive machine learining model	41	12			
Deliverable GUI	46	8			
Final Testing and Revision	41	20			
Prepare Final Presentation	56	5			
Viva	60	1