

BMET9922/2922: Pulse Sensor System Final Report

Due: Week 13; Worth 40%; Max 12 pages plus references.

1. Introduction

The purpose of this project is to explore and implement a range of computational signal analysis techniques using a PPG signal. These began with the signal acquisition from the sensor, then included basic feature extraction (the heart rate), formatting and transmitting the data in an IoT context, more sophisticated analysis techniques like FFT, and finally creating an interactive visualisation of the data in the form of a graphic user interface.

The aim of this report is to describe your journey in six ways:

- Selling your system to the reader is a worthwhile piece of research and development.
- Outlining the system, you have developed, both at a higher level and the technical specifics.
- Explaining and justifying the design decisions you have made.
- Explaining your development process.
- Communicating the efforts that each group member contributed.
- Suggesting future directions if the work was to continue.

Using ideas from the first two design reports is acceptable, but you must revise these ideas in light of what you have learned and synthesize the work of the various group members into a new piece of writing for each section.

The code files must be submitted along with the report, as described in the section below entitled "Submission."

2. Report Sections

This report must follow the sections described in the table below:

section	Description	% of Mark	Tables or Figures (maximum allowed)	Counted in max. length allowed?
Title page	Should include the names/SIDs of group members and a proper title, as if you are publishing a research paper.		0	No
Table of contents			0	No
Introduction and Background	Outline what PPG is and what it can tell us about our health. Summaries why there is a	10%	1	Yes, max. 1 pages

	clinical need for this knowledge. Sell the significance of this work. Provide a brief overview of current PPG technology and alternative technologies, including the relative strengths and weaknesses of PPG. Think of this as a mini literature review. You should also name your product and mention it in this section.			
System Description	Give a description of the system we are building, based around a block diagram. The block diagram may include hardware, but it should be focused on communicating the software design. Provide descriptions for each block.	20%	2	Yes, max. 2 pages
Signal Processing	Summarise the signal processing techniques you have used. Including diagrams and equations if appropriate, but you must fully explain them, including all terms in any equations.	15%	2	Yes, max. 2 pages
Design Justification	Explain and justify any design decisions that are unique to your system, beyond the scope of the requirements, or that you feel are interesting solutions to the requirements. This may include background research and trial-and-error optimisation.	20%	1	Yes, max 2 pages
Design Process	Explain how you allocated tasks, decided on checkpoint milestones, and created a timeline. Discuss if any major revisions to the system or timeline were required. Also explain any testing you conducted. A Gantt chart may be included, representing either the original plan or what took place.	10%	1	Yes, max 2 pages
Group member contribution	Describe the contributions of each group member. You can reference specific functions or modules in the code and sections in this report.	15%		Yes, max 2 pages
Conclusion	Summarise this report and briefly outline what future steps might be taken if the work was to continue.	5%	0	Yes, max. 1 page
References	At least 8 references	5%	0	No

Total	-	100%	7	No, min 8 references
-------	---	------	---	----------------------

3. Formatting

All tables and figures must have captions and be properly numbered throughout the report. No table or figure, including its caption, should take up more than 1/2 a page, apart from a Gantt chart. The body of the report should consist only of written content, figures and tables (e.g. no embedded videos etc). The font should be Arial 11pt, the page size should be A4, and the margin width should be 'normal'.

There should be at least 8 references, that must be properly formatted according to the [IEEE standard](#). These may include academic papers, datasheets, textbooks, or educational content, etc.

4. Introduction and Background

This section is similar to the equivalent in Design Report Part I; however, it should not be identical to any single group member's submission. You must take what you have learned throughout the course and produce a new piece of writing that may or may not be a synthesis of each group member's previous submissions.

5. System Description

Unlike the previous two design reports, this section is to describe the system you have built. It should again centre around a block diagram that is free to be a mix of hardware and software but must primarily communicate the software design. Not all system modules and functions must be presented as a block in the diagram, but the behavior and core features of the system must be fully captured by the diagram (e.g. you may not have a separate block just for button debouncing, but you should have some kind of button block and the debouncing should be communicated somehow in the diagram or text). This must include arrows between blocks that represent data flowing into and out of each block, and the nature of that data must be described in the diagram or in the text.

You do not need to go into specifics regarding variable types etc. as that will be observable in your code. But you should explain what values are flowing between blocks, e.g., 'sensor sample', 'list of sensor samples', 'heart rate calculation' etc. The text for this section should be focused on explaining the block diagram.

6. Signal Processing

This section must explain any signal processing techniques you implemented, such as threshold detection, adaptive threshold detection, FFT, filtering etc. You must explain the technique and why it is appropriate or effective to apply it in this context. You can also explain how you implemented if it was done in an interesting way, but there is no need to refer to specific libraries etc.

7. Design Justification

In this section, you should explain **and justify** any design decisions you made that are beyond the scope of the requirements, or that are within the scope but done in an interesting way. This should at least include the button and LED functions you implemented, as they were left for each group to decide. Beyond that, examples might be GUI features, choice of alarms, moving window sizes for FFT etc. Or you may have implemented packet construction, adaptive threshold detection, heart rate calculation or scheduling (on the microcontroller) in interesting ways. Practical concerns like simplicity, robustness, less uncertainty, and time requirements are valid justifications.

8. Design Process

Here you must outline your design process. This may include an initial review of each group members' previous works, brainstorming of system features, assigning tasks, developing a timeline, deciding on checkpoint milestones, deciding testing protocols, deciding on backup plans etc. It should also mention any major revisions required, for example to the system design, the timeline, the checkpoint milestones, or the roles.

9. Group Member Contribution

This should outline what each group member contributed, for example implementing the system, writing the report, organisation, documentation etc. It should be written and agreed upon by the group. While this section is weighted as 15% it may influence the final individual marks of each member. If there are serious issues or disagreements here it is best to contact Omid or Daniel to discuss. Group members will tend to get the same mark for this report unless a large deviation in the contribution is clear.

10. Conclusion

In this paragraph, you should summarise what you have presented above and enhance the potential impact of your work. In addition, future steps may be discussed if the work is continuing.

Submission

These are the submission requirements. There will be less flexibility than with the previous submissions:

A single compressed file (for example a .zip file) must be submitted. This file must include the practical session of the group (not of the individuals, if they are from different practicals) and the group number. An example of the format is:

group24_prac2_final_report.zip

This file must be submitted via Canvas. Email submissions will **not** be accepted under any circumstances.

This compressed file must contain the following:

- o A single PDF document: the final report. No other file format for the report will be accepted; it must be PDF. No other PDF documents should be included.
- o All code required to run your system. This must include at least one .py and one .ino file but can include multiple .py files if they are required. It can also include any test files used (but these will not be run). **Note: it is recommended that each function, file or module includes the author's name in its documentation, so we can get a sense of individual contributions.** It is also recommended that the code be well documented and formatted. Some advice can be found [here](#), and you can also find some examples of great code [here](#).

Penalties

- Late submissions will attract a deduction of 5% per day from the mark awarded. For example, an assignment that is 2 days late, or part thereof, which achieved a mark of 80% will have the mark adjusted to 70% ($2 * 5\%$).
- Assignments that are more than 10 days late will not be accepted.
- **Extensions:** if an extension is required, you must apply through the [special consideration portal](#)- or may have been considered in your Academic Plan. If you believe we may not have your Academic Plan please share it with us via the Course Coordinator's email to Dr Omid Kavehei.
- If you have applied for special consideration, you must let us know asap, and inform us of the result as soon as you receive it. **This does not apply to simple extensions; you do not need to tell us about those.**
- **DO NOT** wait for your special consideration result before submitting. They are taking a long time to get back to students, so by the time you receive your result, your extension may have already passed. After applying for special consideration, still submit as soon as you can because you do not know what their decision will be, or how long it will take.

END OF DOCUMENT