

Design, Development, and Creations of a “Medical System”

Medical Technology Special Topics

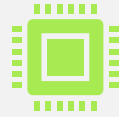


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V-Model (Project Management)
Project Architecture



Sensor



Analog

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Analog Circuit
Analog Board
Analog Signal



Digital

Digit System Requirement
Digital Setup
Software Development



Result



Future Work



Project Management

- Work carried out through the V-Model of Product Development (Figure 1)
- Project split into two teams:
 - Analog
 - Digital

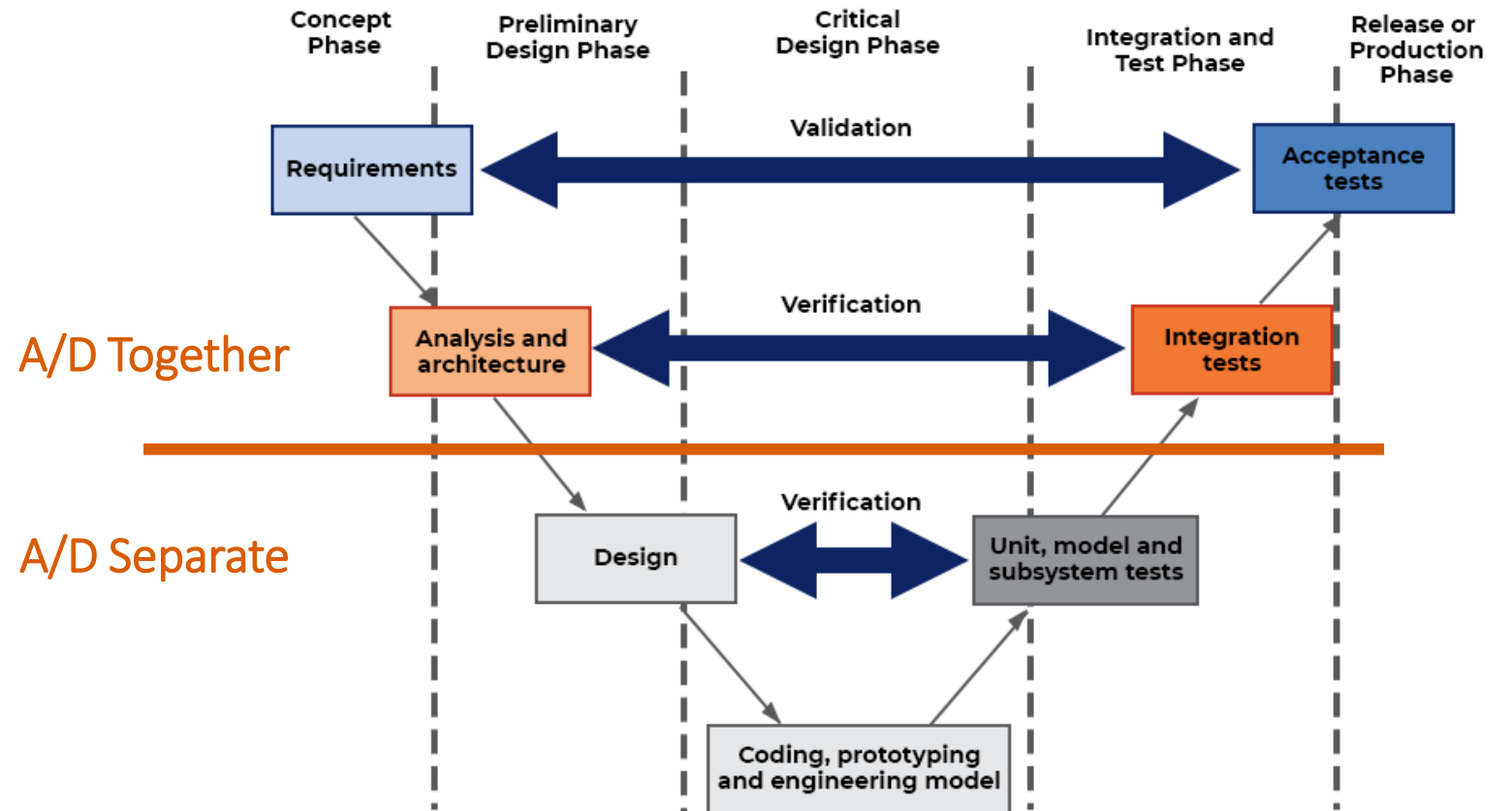


Figure 1: V-Model of Project Management





Project Architecture

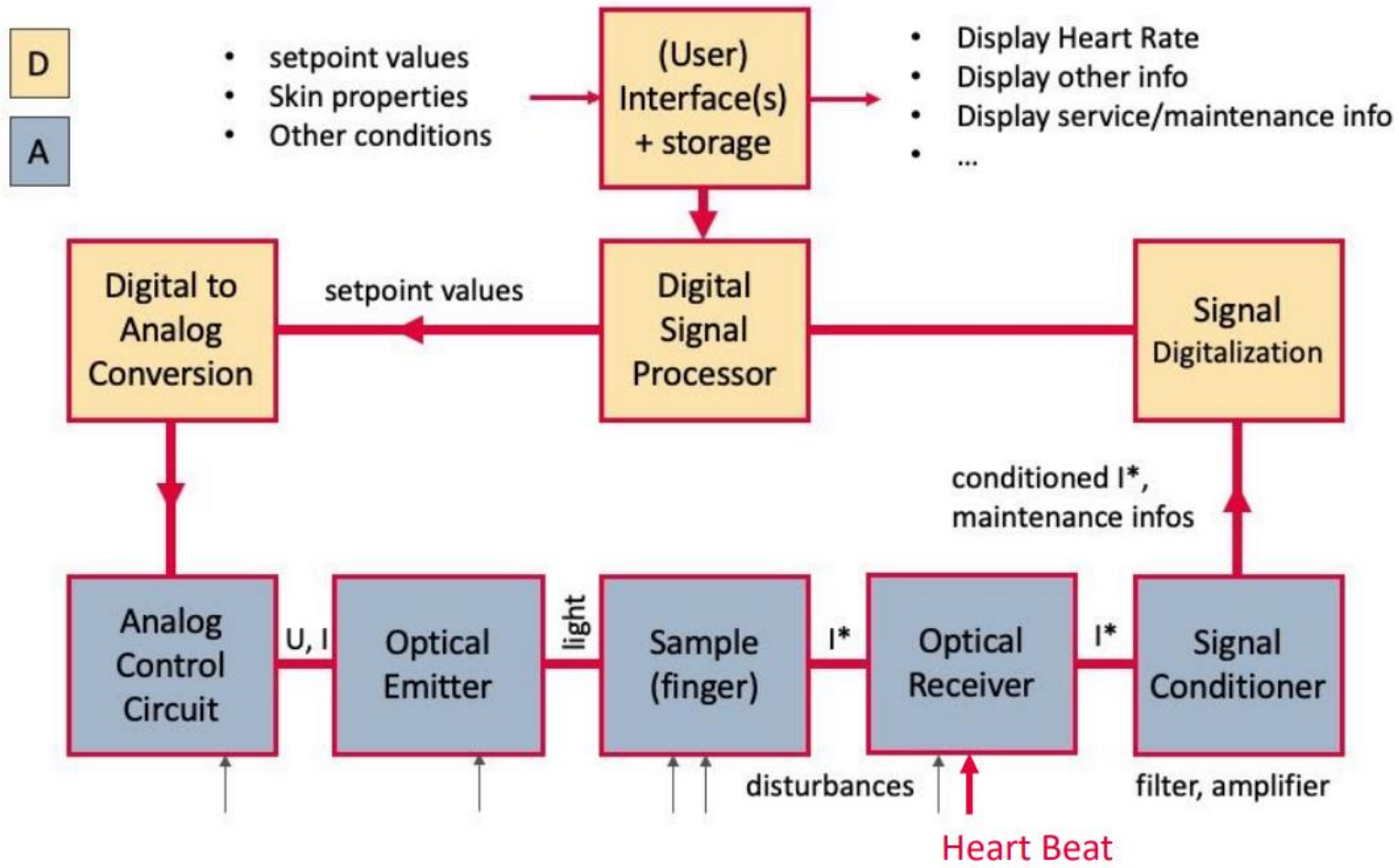


Figure 2: Responsibilities Outline for Reference Course





Sensor

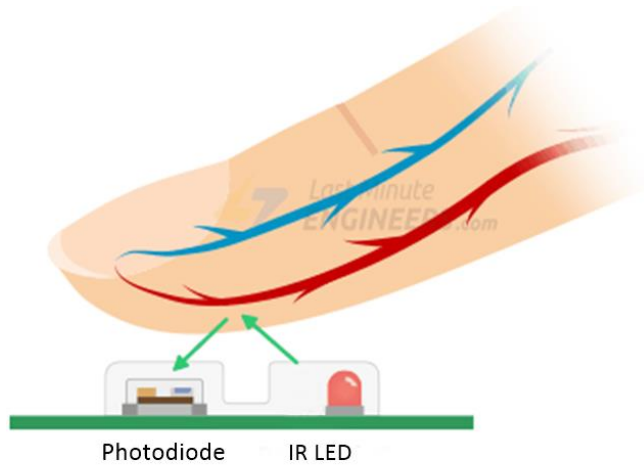


Figure 3: Sensor Configuration

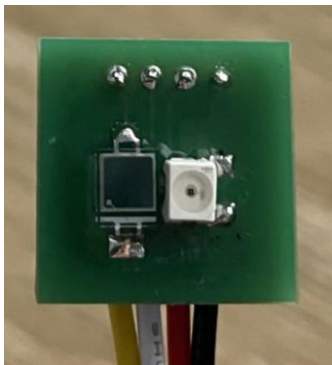


Figure 4: Sensor

Wavelength (infrared)	LED	850 nm
	Photodiode	400-1100 nm
Operation and storage temperature range	-40 ... 100 °C	
Forward and Reverse Voltage for LED	Forward Voltage	$1.5 \leq (1.8) \text{ V}$
	Reverse Voltage	5 V
Forward and Reverse Voltage for Photodiode	Forward Voltage	1.3 V
	Reverse Voltage	32 V
Short-circuit Current	80 μA	

Table 1: Sensor Datasheet





Analog System Design

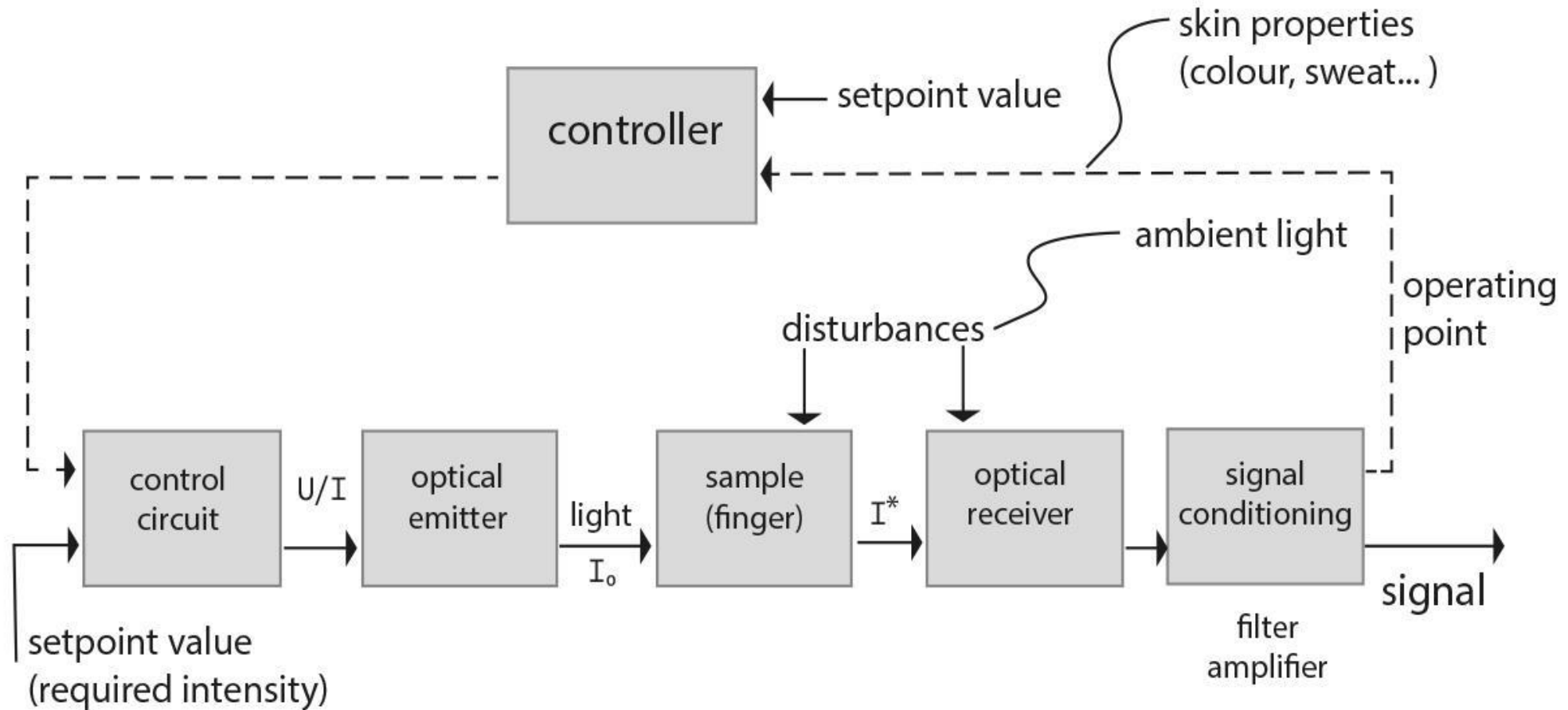


Figure 5: Analog System Architecture





Analog Circuit

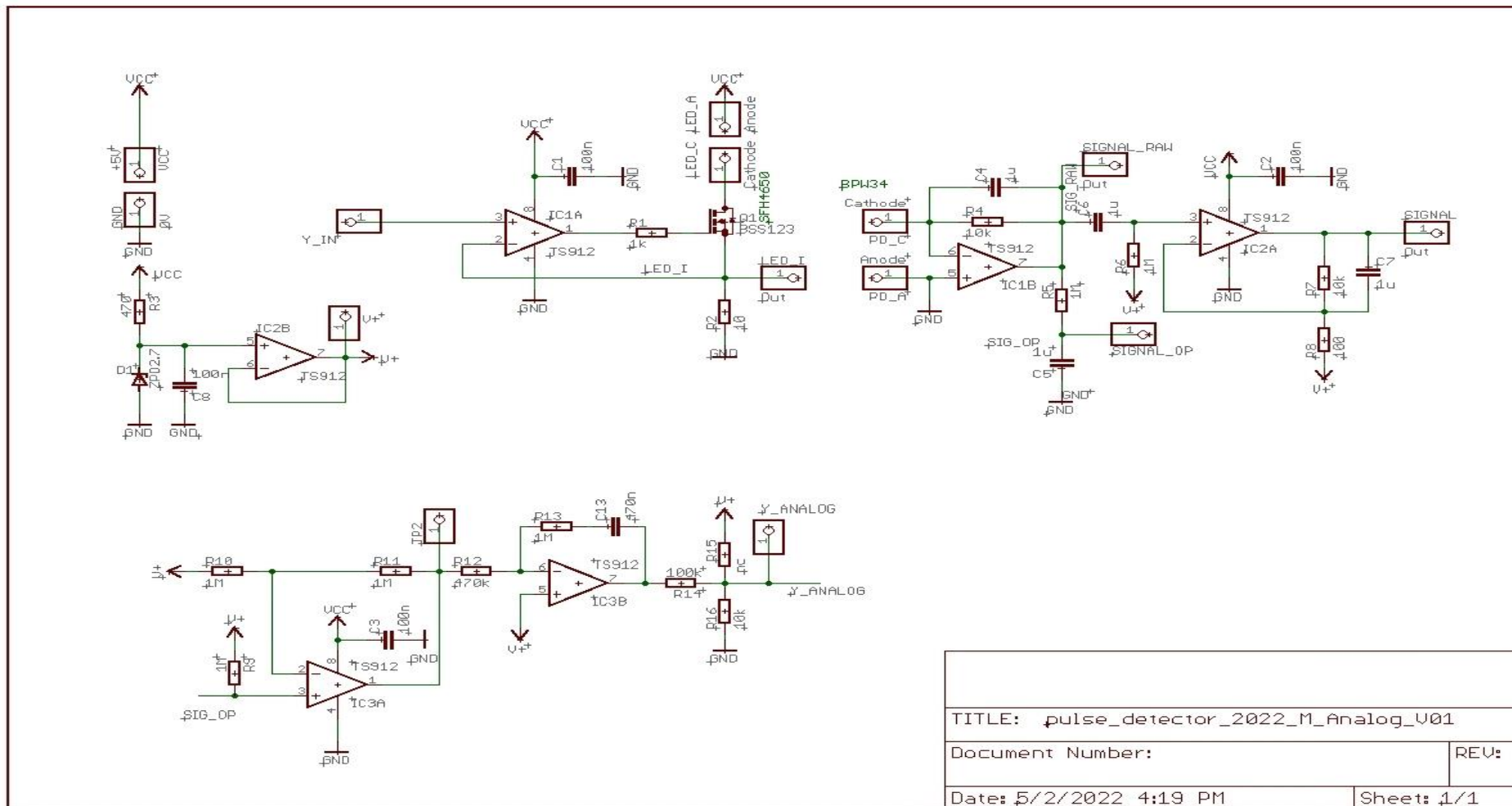


Figure 6: Circuit Simulation with LT Spice





Analog Board

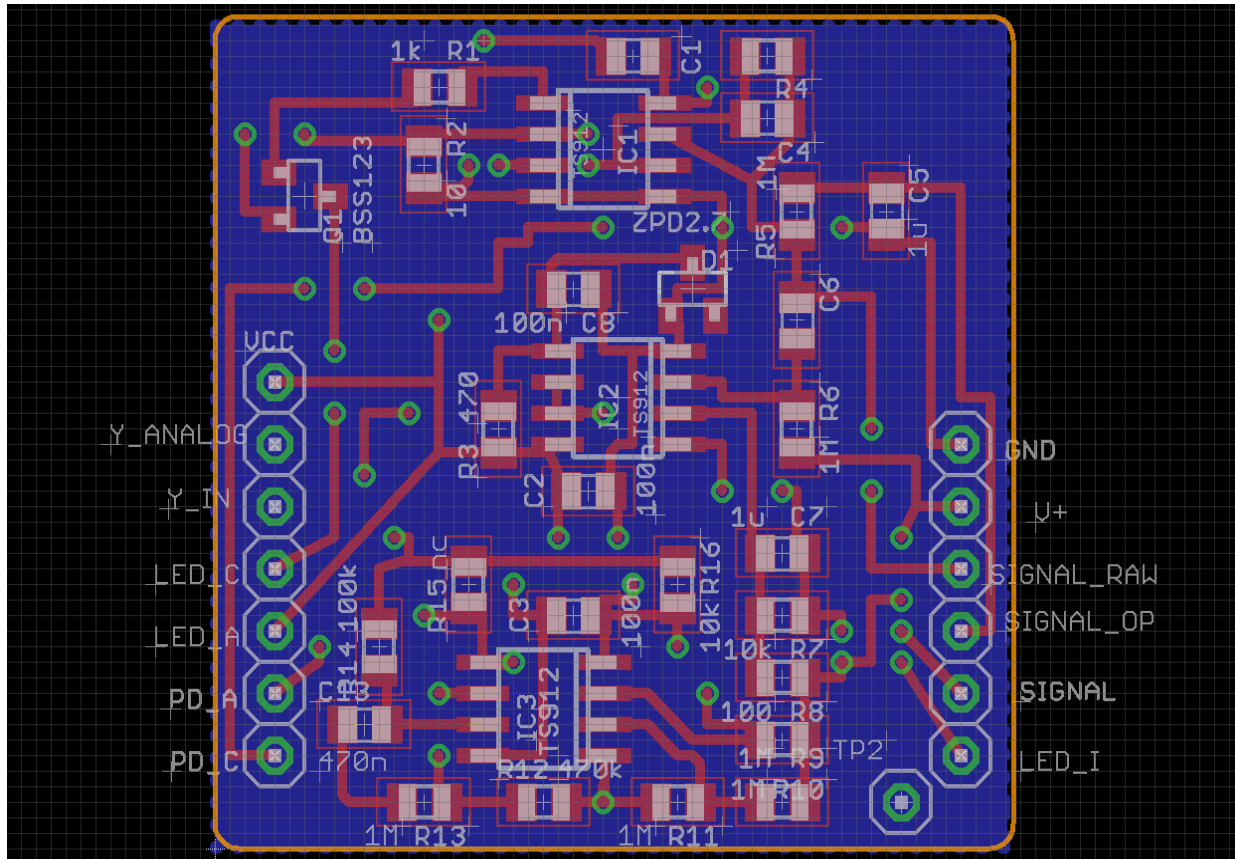


Figure 7: Final Circuit Design with Eagle CAD

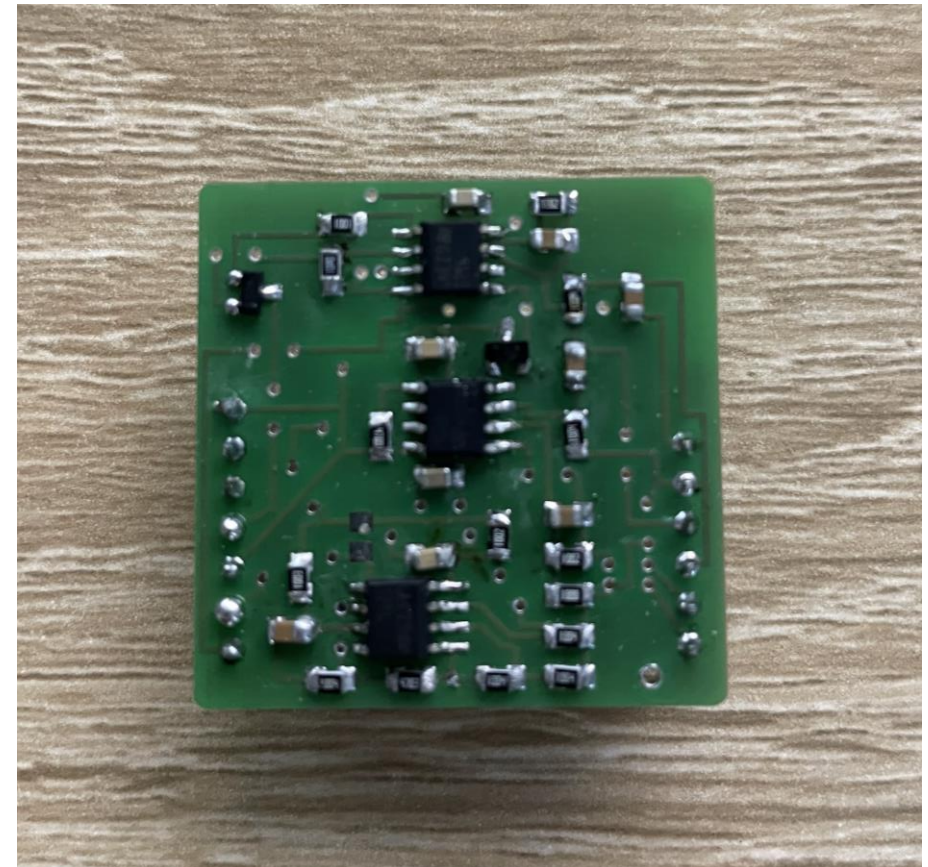


Figure 8: Analog Board





Analog Signal



Figure 9: Sensor Signal

Electrocardiogram

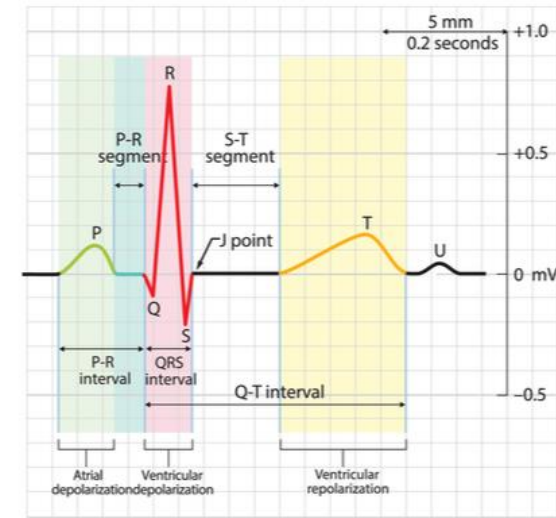
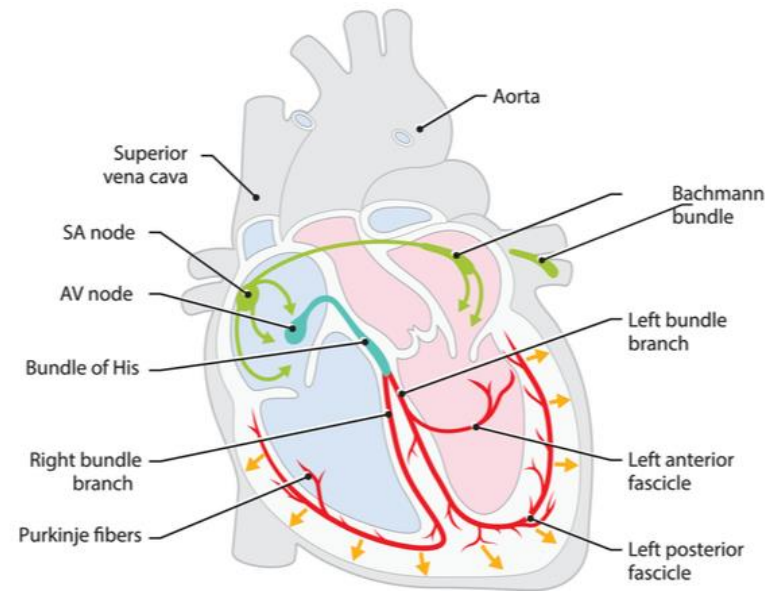


Figure 10: ECG Signal Description





Digital System Requirements

Number	Description of Requirement	Detailed Description
SRS_01	Visible output of heart rate data	Data about the heart rate to be displayed on the monitor in real time (<1s).
SRS_02	Able to compute statistics	Collected data must be analyzed with statistical algorithms for pattern recognition.
SRS_03	Alarm system	The device must have an alarm system (auditory and visual) to alert hospital staff.
SRS_04	Save heart rate data with ID	The data saved to the machine must belong to a specific patient ID.
SRS_05	Accurate measurement of HR	The measurement of the heartrate must be accurate enough to determine heart status at any given moment.
SRS_06	Measure relevent system parameters for system servicing	Contains self-diagnosis tools for easier/faster servicing.

Table 2: Requirements List for Digital Section Reference Course





Digital Setup

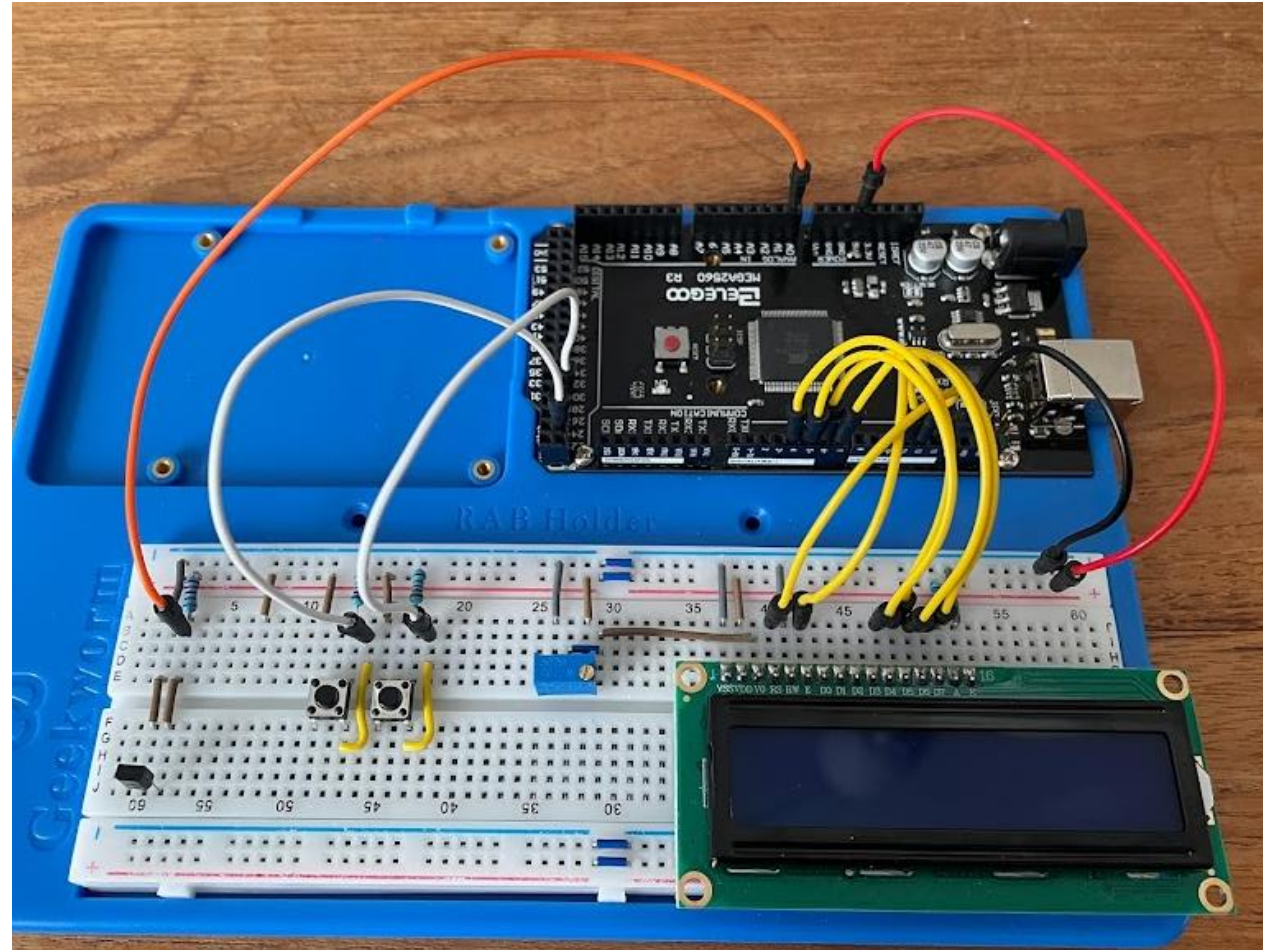


Figure 11: Initial Digital Setup





Software Development

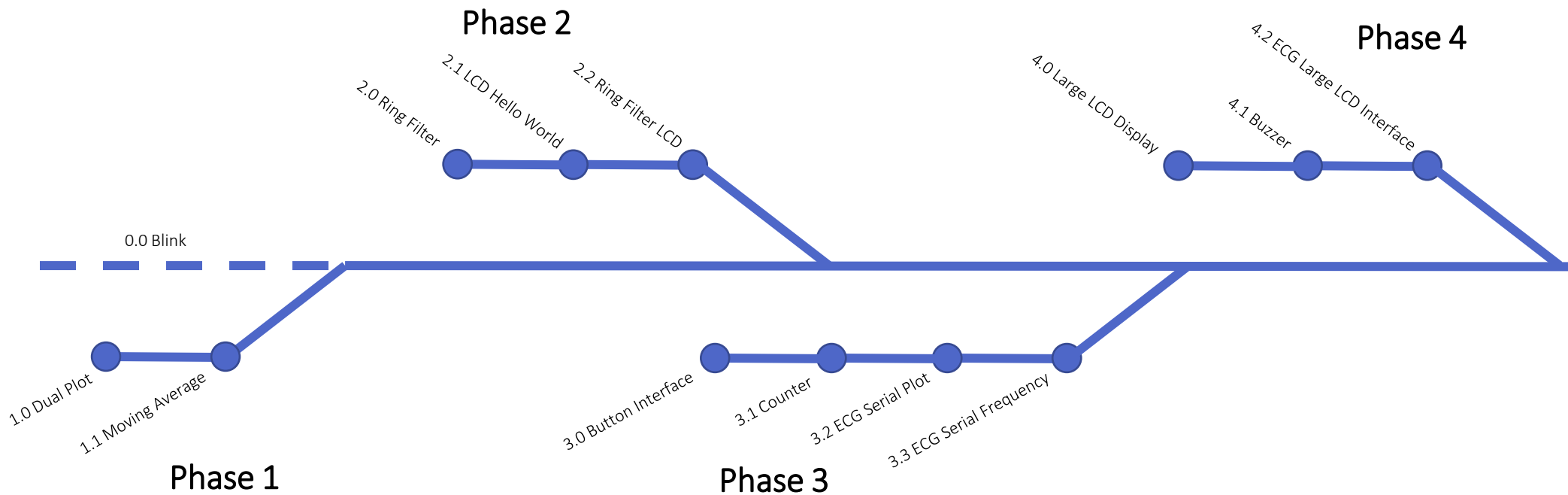


Figure 12: Software Development Progression

- All problems, no matter how complex, can be broken down into easier parts





Result

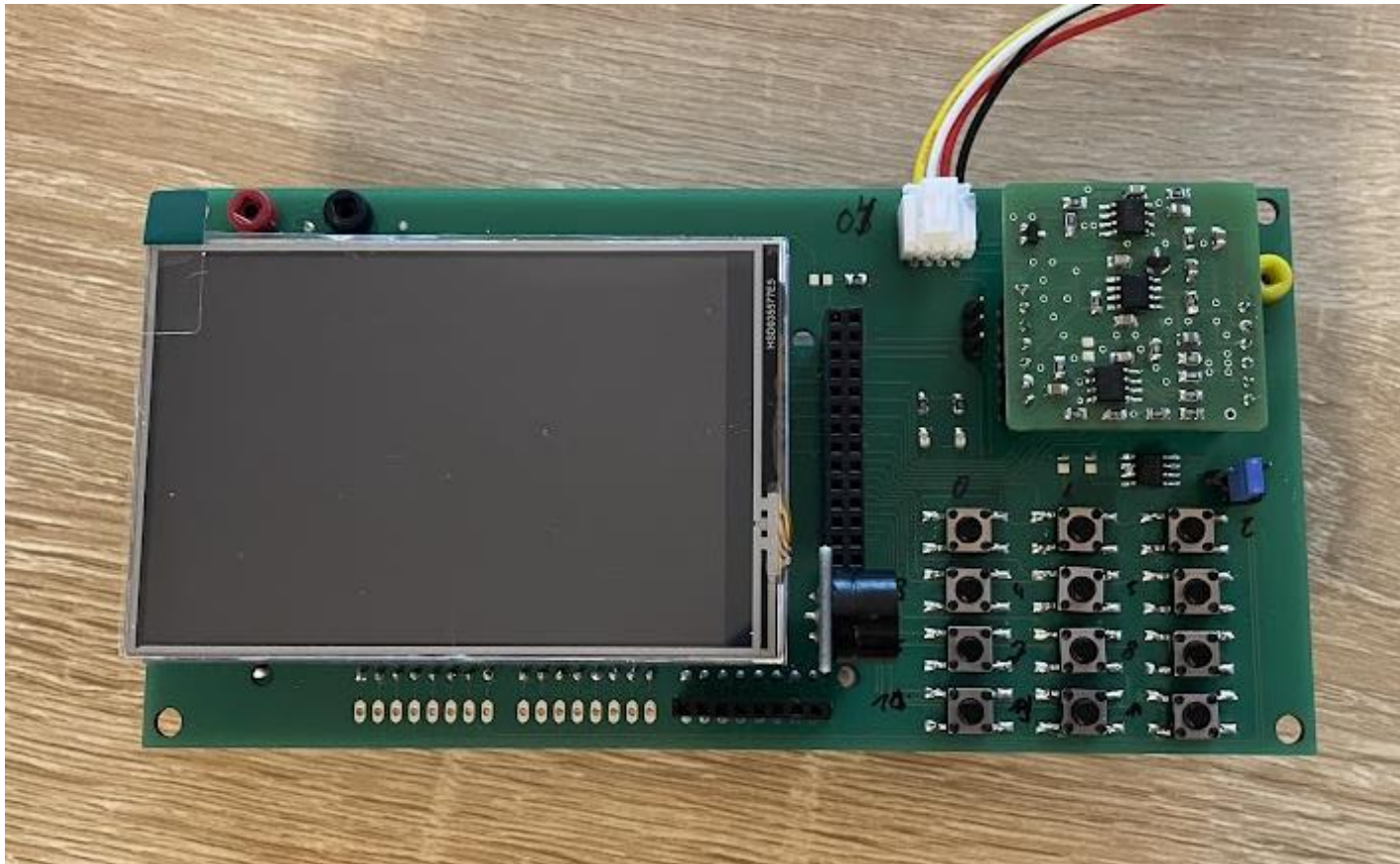


Figure 13: Final Digital Setup



Future Work

Number	Description of Requirement	Detailed Description
SRS_01	Visible output of heart rate data	Data about the heart rate to be displayed on the monitor in real time (<1s).
SRS_02	Able to compute statistics	Collected data must be analyzed with statistical algorithms for pattern recognition.
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SRS_06	Measure relevent system parameters for system servicing	Contains self-diagnosis tools for easier/faster servicing.

Table 3: Incomplete Requirements List



References

- [https://kruschecompany.com/de/v-modell-softwareentwicklung/#Das V-modell Diagramm](https://kruschecompany.com/de/v-modell-softwareentwicklung/#Das_V-modell_Diagramm)
- <https://www.edeninternalmedicine.com/el>
- *Medical Technology Course Materials*

