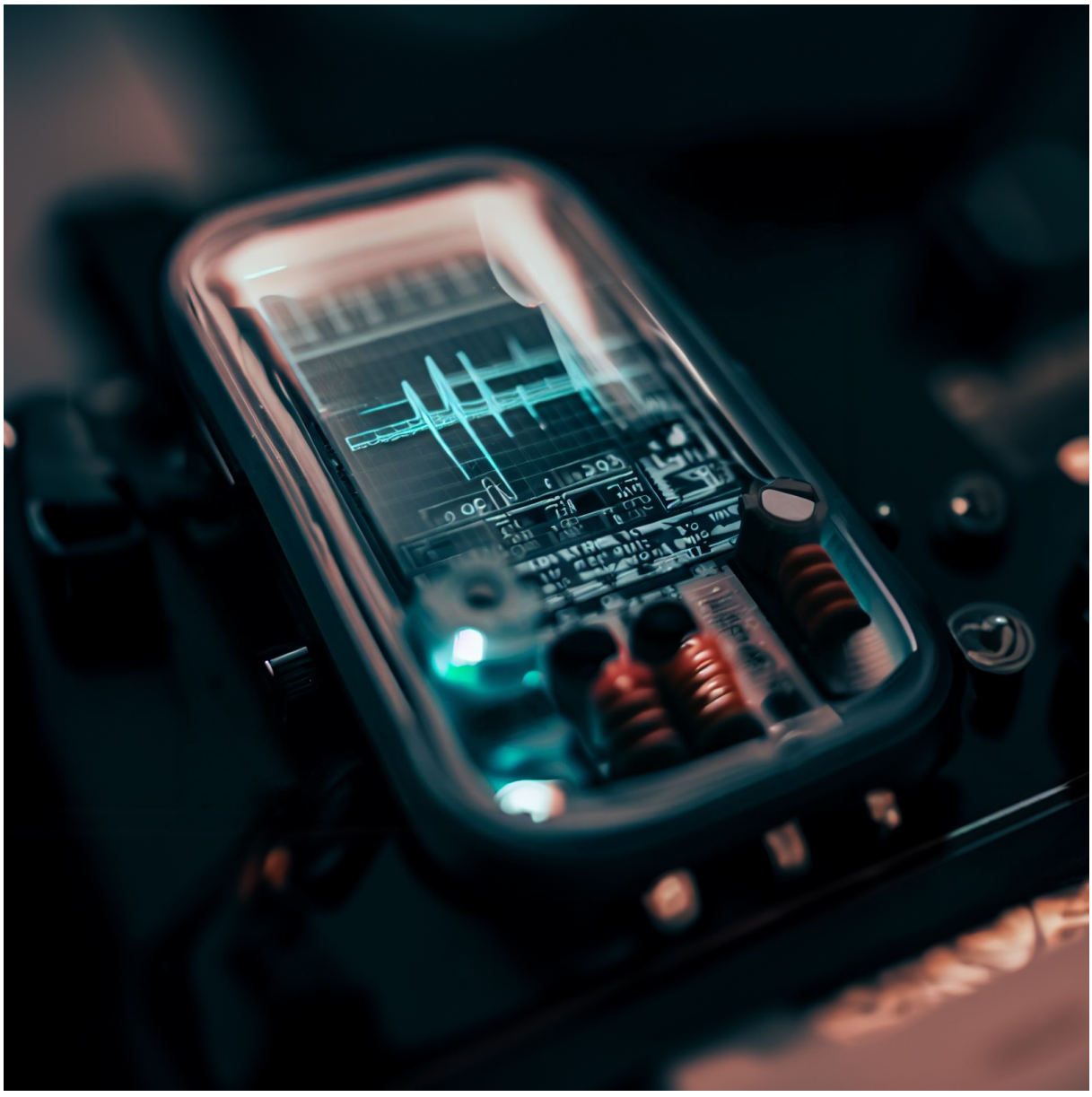
HST Project S5

CircuitVoyager Pre1



Submitted by:
Joel Schaller

Lecturer: Enrico Malacarne

22.09.2023

Abstract

Konzept (gestalterisch)
Methode
Wichtigste Ergebnisse

Contents

1 Introduction

The goal of this project is to develop a tiny extension Board for the STM32H747i-Disco Board, to allow it to act as a DMM. Additionally, a SW, that measures the DMM Values and displays them on the Touch Display. If there's more time I could extend the Project with Measurement Logging via a SD-Card or over USB to a Desktop application.
I want to learn how to implement high speed protocols such as Mipi DSI or QPSI. Later in the last year of my apprenticeship I'd like to develop a whole DMM on my own, but with a different approach as standard ones like these from Fluke. For example, I want to make the DMM rechargeable and modernize it a bit.
To realize this project I'm going to use the following tools: Altium Designer, STM32-CubeIDE, LaTeX, TouchGFX.
Also I won't make a diary, because it's easier for me to write my findings down sorted by theme rather than date. But to keep the chronological order of the stuff I've done, there's a Journal in Chapter: [4.1].

1.1 "Lastenheft"

This is a request from the imaginary customer, I'm making this project for:
I need a prototype for a DMM, that can measure voltage, current, resistance and capacitance. The DMM should have a touchscreen that displays said values. The UI should be intuitive, so everyone who's ever used a DMM can use it to. Normal features as hold, minmax should be available and it would be great if you could fit in a power mode, where the DMM uses the voltage and current measurement to calculate the drawn power from the measured device. Because this project will only be used for the proof of concept, the DMM doesn't have to support mains voltage and we also won't need any safety circuits. It's mainly about the SW. So you can also use DevBoards if there are any available.

1.2 Mindmap

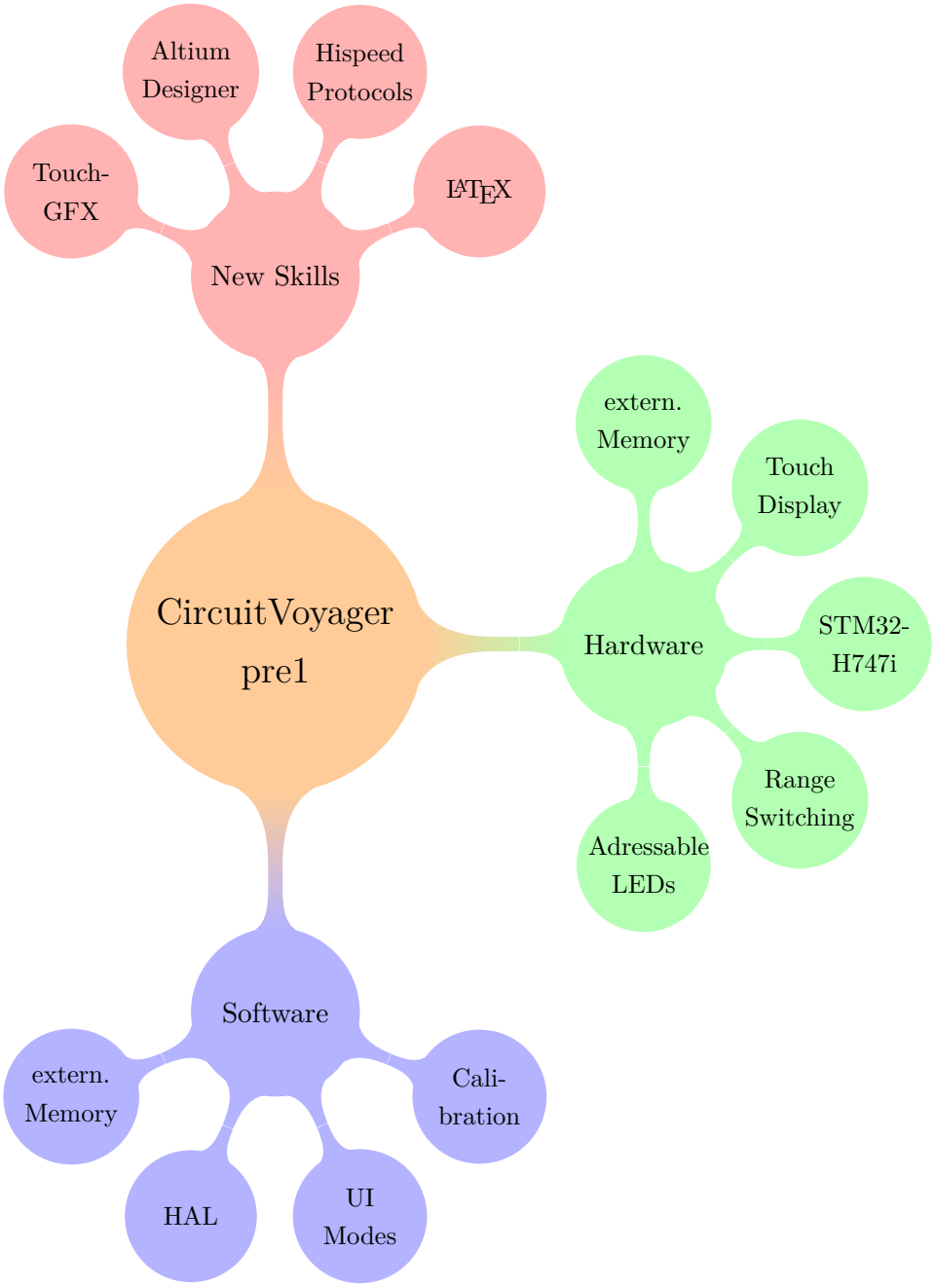


Figure 1.1: Project Mindmap

2 Main Body

2.1 "Pflichtenheft"

Cost

I've already bought two DevBoards one of them stays at TBZ and the other is at home. One of these boards was paid by Mr. Malacarne. Further expenses from the PCB will be paid by me and shouldn't exceed about 50 CHF, as the HW isn't that complicated.

Time

The most time of the project I will work at home because it's a rather big project to execute in one semester. I will also have much time in the fall holidays to work on it. The project will approximately take 100h to complete. Also the more detailed timeplan is in chapter: [4.3]

Tools

To realize this project I will mainly use, the SW STM32CubeIDE with HAL and Altium Designer. The documentation is written in LaTeX in VSCode. And I'm planning to order the PCB on JLCPCB and I will populate and reflow the PCB at ETHZ, where I'm also allowed to use the measurement equipment for the HW tests.

Technical Details

value	min.	typ.	max.	unit	description
supply voltage		5		V	

Table 2.1: Technical Details

3 Conclusion

Gesamtschau, Arbeitsergebnis, Gesamturteil, evtl. Ausblick, was ich lernen konnte

4 Appendix

4.1 Journal

Date	Location	Duration	Activity
01.09.2023	TBZ	1.5h	Selected and bought DevBoard
08.09.2023	TBZ	2h	Tested DevBoard with demos
08.09.2023	TBZ	0.5h	Noted first ideas for DMM
15.09.2023	TBZ	1.5h	Written and signed Project Agreement [4.2]
21.09.2023	Home	3h	Created documentation template
22.09.2023	TBZ	2h	Started writing Journal [4.1]
24.09.2023	Home	1.5h	Made GANTT chart [4.3]
27.09.2023	Home	2h	Written detailed planning and introduction
29.09.2023	TBZ	1.5h	Added mindmap, Lasten-, Pflichtenheft

Table 4.1: Project Journal

4.2 Project Agreement

Information TBZ/EE / **2337.00** HST
jschaller
HST: BüP *Sem:* **5** 1_Project_Agreement.docx
TBZ Technische Berufsschule Zürich Abteilung Elektro/Elektronik

1 Projektvereinbarung

Verfasser/innen: Joel Schaller **Klasse:** BEN21
Titel: CircuitVoyager pre1

1. **Thema** (Hintergrund, Überblick, gegenwärtiger Wissensstand)

Develop a tiny extension Board for the STM32H747i-Disco Board, to allow it to act as a DMM. Additionally, a software, that measures the DMM Values and displays them on the Touch Display. If there's more time I could extend the Project with Measurement Logging via a SD-Card or over USB to a Desktop application.

2. **Eigene Fragestellung / Untersuchungsgegenstand**

2.1 Eigene Fragestellung (Leitfrage)
How to implement the following functions / protocols? (QSPI Flash, SDRAM, TouchGFX, Mipi DSI) and if the time is sufficient: (FAT with SDcards, Bootloaders)
2.2 Hypothese (Vermutung über das Ergebnis)
I want to learn, working with High Speed MCUs and implement such protocols.
2.3 Methoden und Vorgehen (mindestens 2 Methoden müssen angewendet werden)
HW-Dev (Altium), SW-Dev (STM32Cube with HAL), Documentation in LaTeX
2.4 Hilfsmittel
Internet, literature
2.5 Kontaktpersonen, Informationsstellen, Institutionen
Teachers, Instructor at ETH, Dad

3. **Persönlicher Bezug / Motivation**
In the next 2 Years I want to develop my own DMM, because I think there's much to improve with standard DMMs as Fluke. For Example: Touch Display, Rechargeable Battery…

4. **Bewertungsform**
This Project will only be done by me. Time: about 28 lesson and unknown time at home.
Project delivery on: 12.01.2023

5. **Besprechungstermine mit Lehrperson** (vorgeschrieben sind zwei Besprechungen)
Termin 1: 27.10.2023
Termin 2: 01.12.2023

Datum: 15.09.23. Die Lernenden: .....

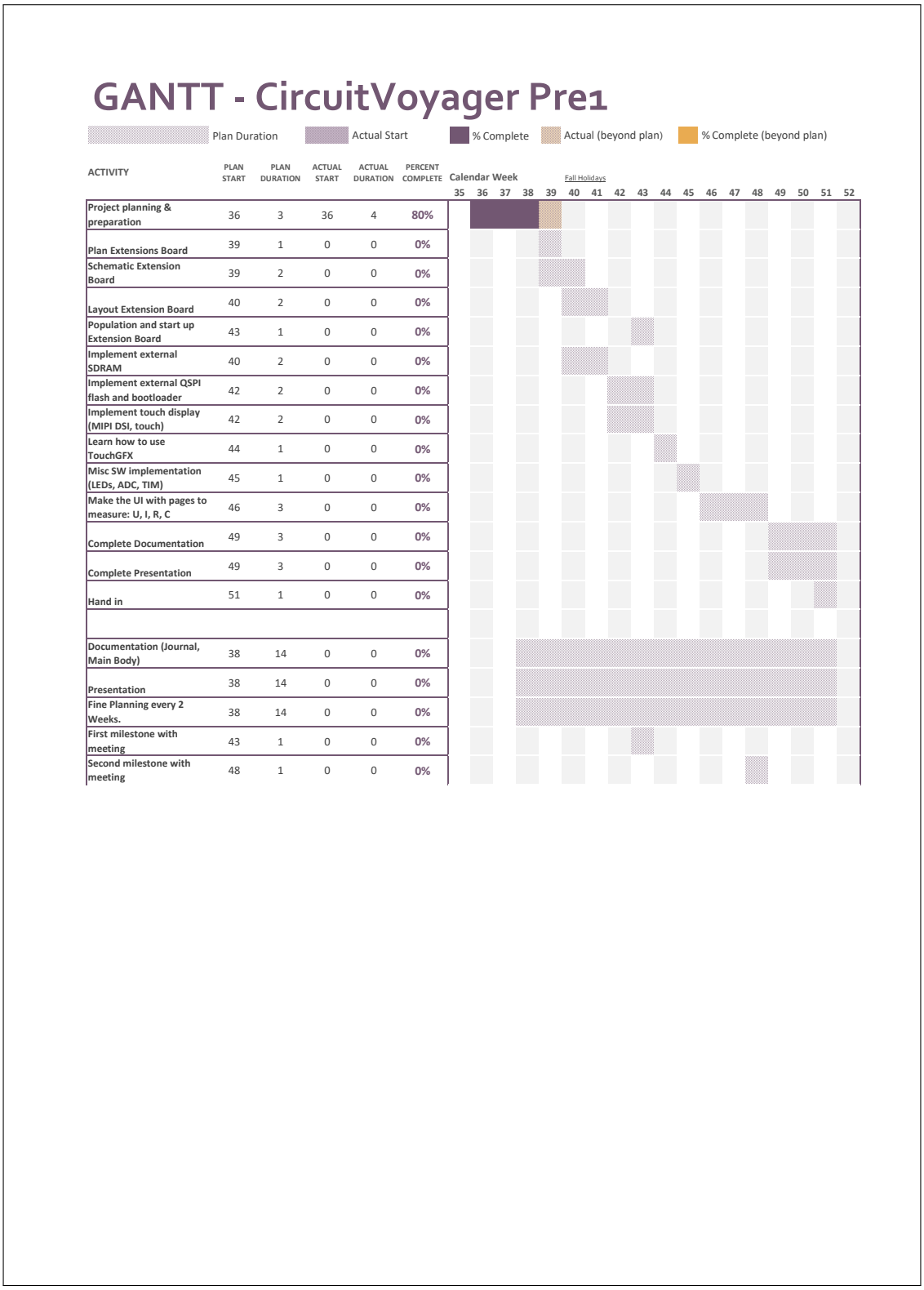
Datum: 15.9.23 Die Lehrperson: .....

DMM = Digital Multimeter
TouchGFX = Graphical Designer for Embedded Touch Displays

BEN21 Seite 1 (1) 1_Project_Agreement.docx

Figure 4.1: Project Agreement

4.3 GANTT Chart



ACTIVITY	PLAN START	PLAN DURATION	ACTUAL START	ACTUAL DURATION	PERCENT COMPLETE
Project planning & preparation	36	3	36	4	80%
Plan Extensions Board	39	1	0	0	0%
Schematic Extension Board	39	2	0	0	0%
Layout Extension Board	40	2	0	0	0%
Population and start up Extension Board	43	1	0	0	0%
Implement external SDRAM	40	2	0	0	0%
Implement external QSPI flash and bootloader	42	2	0	0	0%
Implement touch display (MIPI DSI, touch)	42	2	0	0	0%
Learn how to use TouchGFX	44	1	0	0	0%
Misc SW implementation (LEDs, ADC, TIM)	45	1	0	0	0%
Make the UI with pages to measure: U, I, R, C	46	3	0	0	0%
Complete Documentation	49	3	0	0	0%
Complete Presentation	49	3	0	0	0%
Hand in	51	1	0	0	0%
Documentation (Journal, Main Body)	38	14	0	0	0%
Presentation	38	14	0	0	0%
Fine Planning every 2 Weeks.	38	14	0	0	0%
First milestone with meeting	43	1	0	0	0%
Second milestone with meeting	48	1	0	0	0%

Figure 4.2: GANTT Chart

4.4 Weekly plans

4.4.1 KW39 & 40

- Write introduction
- Planning: Cost, Tools, When, Why
- Create project diagram (learning process)
- "Lastenheft"
- "Pflichtenheft"
- Make a HW-Digram for the Extension PCB.
- Make the schematic of the Extension PCB.
  - Part to measure voltage.
  - Part to measure current.
  - Part to measure resistance.
  - Part to measure capacitance.
  - Addressable LEDs.
- Start with the Layout of the Extension PCB.
- Reflection of the start of the project.

5 Credits

Bibliography

List of Figures

List of Tables

Listings

Acronyms

CircuitVoyager The Name of the DMM I'm developing.

DevBoard main microcontroller developement board. (STM32H747I-Disco)

DMM digital multimeter

HW Hardware

SW Software

QPSI Quad SPI

SPI Serial Peripheral Interface (low level protocol)

SDRAM Synchronous Dynamic Random Access Memory (external RAM)

TouchGFX Graphical UI designer for STM32 MCUs

UI User Interface

MCU Micro Controlling Unit

Mipi DSI Digital Serial Interface (Display Protocol)

FAT File Allocation System (Low Level Filesystem)

HAL Hardware Abstraction Layer (STM32 Abstraction Library)

ETHZ Eidgenössische Technische Hochschule

TBZ Technische Berufsschule Zürich

ADC Analog Digital Converter

TIM Timer (Hardware Block in STM32)

PCB Printed Circuit Board