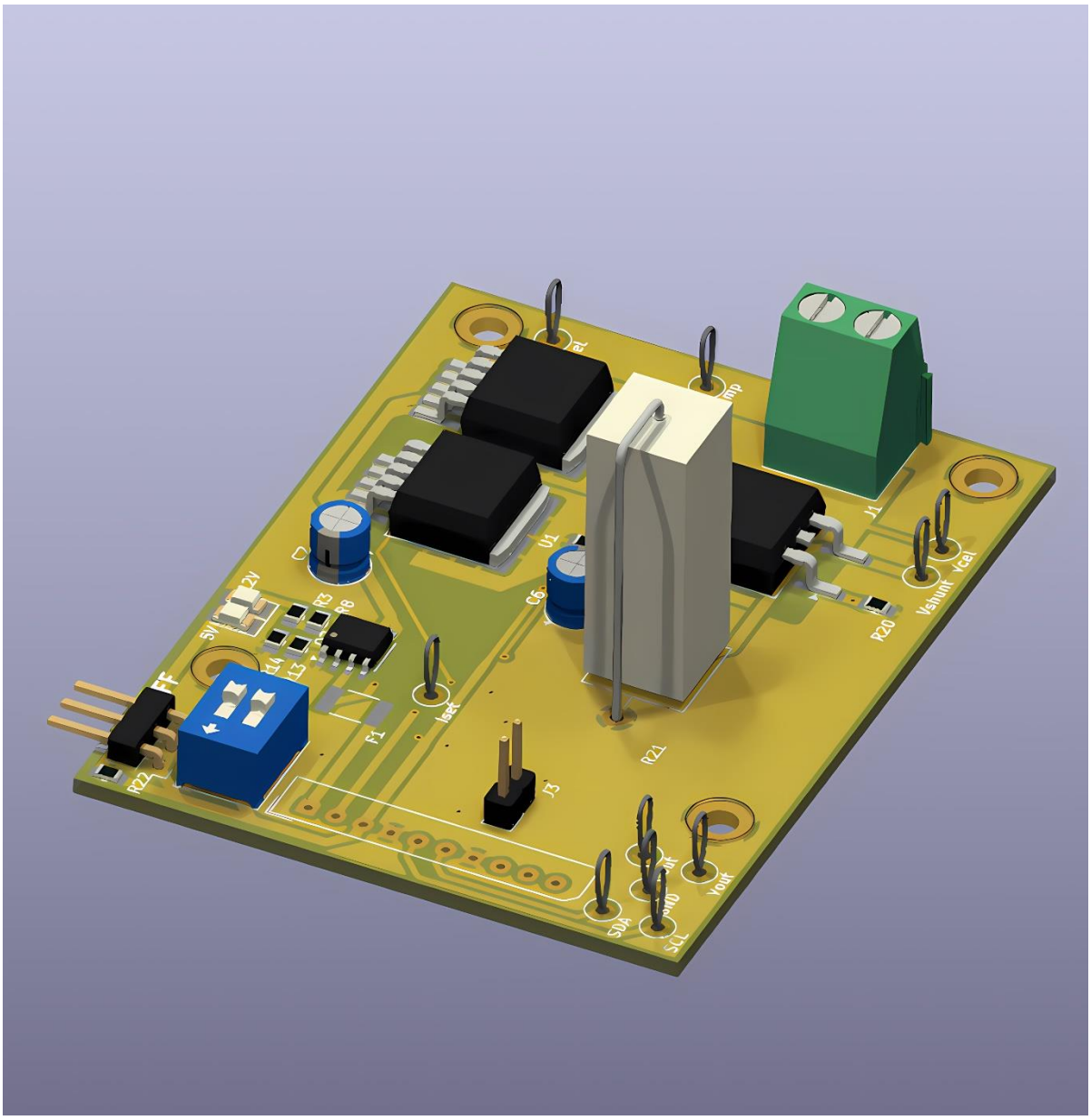
PLAN OF Approach

BATTERY SYSTEM HARDWARE



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Release	Date	Author	Main changes
R01	24-02-2025	Julian Meeuwis	Initialization document.
R02	27-05	Julian Meeuwis	Small update.
R03			

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Table of contents

<The max. length of the POA is 6 pages>

No table of figures entries found.

1. Background information

1.1. Client

This project has been commissioned by BatteryNL. BatteryNL is actively focused on making progress in battery research and development in Europe. The reason for this is to become less independent from other parts of the world, the result is to become more self-sufficient. The main task for the universities and colleges is to focus on safety, performance and integration of the batteries worked on by the companies. All gained knowledge from doing this will be passed on to the consortium so they can continue development.

1.2. Motivation

Battery management system (BMS) testing can be quite hazardous. Modern batteries store a lot of energy, and, if they catch fire, can be difficult to extinguish. On the other hand, an insufficiently tested BMS represents a hazard to users and the environment. The solution is to emulate the battery and the load so that testing can be completed under a wide range of conditions without taking excessive risks. In the past other people and groups have worked on this project. The goal is to continue development where the previous groups left off.

2. The project's results

For this project, a hardware-based battery emulator has already been developed. However, during testing some problems occurred and the system does not include any software that will allow a load or battery type to be emulated on it. This means that there are three main goals to successfully finish this project. This being:

- Testing the hardware: The hardware that has been obtained from a previous group, who worked on it before, must be tested and validated to ensure that the system has full functionality for the use case.
- Emulating a static load and charge profile for specific battery types: many kinds of batteries are being used in the modern world. It is important to BatteryNL that the most used battery types (and maybe even future types) can all be emulated on the hardware used.
- Creating an interface to load dynamic profiles per battery type: to simplify use it is necessary to create a GUI where the different profiles of battery types can be stored and loaded quickly. This must be done to ensure that the speed and efficiency of testing multiple battery types is as high as possible.
- Compared to previous groups, the need to deliver a stable prototype.

3. Project activities

3.1 Introduction

During the introduction, the way of working regarding student research position is introduced. In this phase, it becomes clear what is expected of the student. The goal of the research is discussed in this.

- Doing research about the project itself
- Diving into previous project work
- Organizing way of working
- Start plan of approach
- Communicate goals

3.2 Research / Testing previous work

The functioning of a battery emulator and BMS system is studied, after which the system of the previous group is critically examined. After sufficient knowledge has been acquired, the previous system is tested with the corresponding test plan. During testing, the already known problems are carefully examined and it becomes clear which functions work well or need more attention.

- Test functionality of previous hardware
- Verify real life working with previous simulations
- Implement fix for know problems and troubleshoot new problems

3.3 Troubleshooting previous work

Some known issues and those identified in testing are being resolved on existing hardware where possible. If this is not possible, solutions are looked at. Some problems emerged during the tests of the previous group. Some of these already known problems include:

Gui,

Communication is one of the problems that has become known from the tests of the previous group. The ESP32 is not compatible with the written GUI (matlab).

Heat,

The previous tests also showed that the previous prototype generated a lot of heat.

Oscillation,

Previous testing and simulations have shown that an error was made during the design of the cell modules that resulted in oscillation of the output voltage.

3.4 Revise design

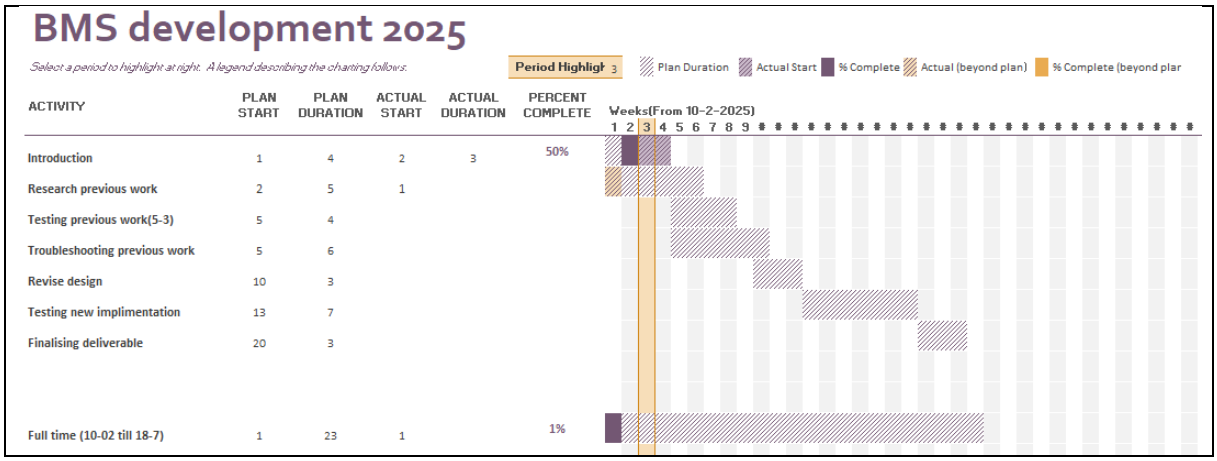
Once the problems have become clear, a revision can be considered. Either a completely new system can be designed or previous can be improved. this applies to both the hardware and the software / user-experience

3.5 Testing new implementation

With the introduction of new hardware, of course, new problems come. These errors are discovered through testing. The system is tested with the usability for the client in mind.

4. Planning

Phases are spread over period 10-02-25 till 18-07-25



Slot	Explanation
Introduction	Get to know the existing BMS system, contact persons and working methods regarding student assistant.
Research / testing previous work	Review previous work and research working, non-working, and possible new modules.
Troubleshooting previous work	Test old design and improve functionality where possible without such major adjustments.
Revise design	Revise old design where necessary with the knowledge gained from, among other things, the tests performed
Testing new implementation	Testing newly developed system and removing errors where necessary
Finalising deliverables	Taking final steps to deliver final prototype. Arrange documents and supplement where necessary.
Full time	Total period in which work is being done on developing BMS.

5. Risks and mitigation

Green	No risk
Yellow	Low risk
Orange	Medium risk
Red	High risk

#	Risk	Action	Probality	Impact
	Oscillation	Change control system of reference voltage LT3080	High risk	Medium
	Heat	-	High Risk	Large
	Communication, GUI does not seems to function with current configuration	Rewrite code to work with current ESP32 or choose other MCU.	Low risk	Medium
	Esp32, esp32-s3-wroom-1-N4R8) does not look like a standard. This could make things more difficult	Change MCU or work with different software.	Medium risk	Large
	Planning, Productivity could decrease because of study pressure.	Try to work a little a head to create some “Breath room”	Medium risk	Medium

6. Intermediate results / Quality management

About halfway through the project, choices must be made to continue with the previous prototype or to design a new system. This choice is made based on the tests that are performed on the current hardware. The customer determines whether there is time for a new design or whether the existing design is improved.

Following the completion of several tests, it has been concluded that the current hardware requires upgrading. Several issues have been addressed, including oscillation and excessively high operating temperatures. However, the new hardware must be thoroughly tested.

A solution to the unnecessary heat development is to reduce the supply voltage, which functions adequately down to approximately 6-7V. A lower supply voltage, however, results in instability and deviating values.