Project — Electronics & PCB for the Sailowtech CTD

- **Project Type:** Semester project
- **Laboratory:** Smart Environmental Sensing in Extreme Environments – SENSE
- **Professor:** Professor Jérôme Chappellaz
- **Supervisor:** Professor Jérôme Chappellaz
- **Student:** To be determined

Context

Sailowtech is an association and a MAKE project that aims to raise awareness of environmental issues, particularly those relating to aquatic environments. It promotes frugal and participative field science, open-source science, and a low-tech approach. To achieve this, Sailowtech organizes scientific sailing expeditions in lakes, seas, and oceans to discover field science, and to test the protocols and devices built by students during the semester.
The CTD is a submersible tool that measures pH, temperature, dissolved oxygen in water, and depth. Collecting this type of data is extremely important, particularly for establishing links between physical phenomena (such as temperature and water acidity) and their impact on marine biodiversity, like plankton.

Description of the Project

The student will take charge of the complete redesign of the CTD's electronic hardware.
As the CTD development is split into two parts, the student selected for this hardware project will work in close coordination with another student focusing simultaneously on the firmware and software architecture.
The starting point will be a critical analysis of existing versions: understanding why the v2 used a Raspberry Pi (and whether it is still the right choice), how the battery PCB managed 12V/5V/3.3V voltages via step-down converters, and how the Atlas Scientific carrier board connected the sensors. From there, the student will need to fulfill the following objectives:

Phase 1 – Priority

- **Evaluate and select a new control platform** to replace the Raspberry Pi (a microcontroller such as an STM32 or ESP32, which is better suited for low-power embedded use). The platform must support wireless connectivity (Wi-Fi/Bluetooth) to enable a future "connected mode" with the Sailowtech weather station.
- **Redesign the battery PCB:** power management, voltage regulation, integrated BMS (Battery Management System), on/off switch, and LED indicator.
- **Redesign the controller PCB:** Interfacing with sensors such as Bar30 for pressure, Atlas Scientific for conductivity, temperature, and dissolved oxygen, waterproof connectors, and UART for debugging, and integrated antenna/RF layout considerations for weather station connectivity.

Phase 2 – Next Development Steps

It is recommended to:

- **Reduce the overall footprint** of the PCB stack to fit into the Blue Robotics enclosure by minimizing its size.
- **Assemble and test the entire system** in the laboratory, working in close coordination with the student in charge of the firmware.

Profile & Logistics

The ideal profile for this project is an autonomous, proactive student, interested initially in prototyping work, and subsequently in calibration and measurement in the laboratory. This project has been set up in partnership with Prof. Jérôme Chappellaz's SENSE laboratory. **The student will have to travel to Sion for the characterization phase** once the prototype is complete; the lab will cover transport costs. The other stages of the project can be carried out on the EPFL campus in Lausanne.
Below is a photo of the already operational MAKE CTD v1:

Indicative Calendar

- **Weeks 1 & 2:** Meet J. Chappellaz and Sebastien Lavanchy of the SENSE Lab.
- **Week 3:** Get to know the project and the various modifications needed to finalize the system.
- **Weeks 4, 5 & 6:** Refine the control plattform.
- **Week 7:** Intermediate presentation with Sailowtech.
- **Weeks 8, 9 & 10:** Redisign the PCBs.
- **Weeks 11, 12 & 13:** Assembly and GitHub documentation.
- **Week 14:** Final presentation with Sailowtech.

Deliverables

- PCB design files (KiCad or EasyEDA)
- Electronic schematics
- Manufactured and tested PCBs
- Final report
- Assembly documentation

Documentation

As a starting point, you can find the documentation for our current CTD version here:
https://github.com/Sailowtech-draft/Sailowtech-CTD

Planned Interaction with Sailowtech

The objective of this project is to develop a device that can be used during a Sailowtech cruise or an instrument test campaign. Consequently, there will be several meetings with Sailowtech (approximately seven per semester, or as required) to monitor progress. Furthermore, the relevant technical staff at Sailowtech will be available for advice and assistance every two weeks.
Finally, you will be considered a member of Sailowtech, and will therefore be able to take part in our various activities and potentially test the device during one of our expeditions.

Contact

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