KernowSat-1 Buoy System

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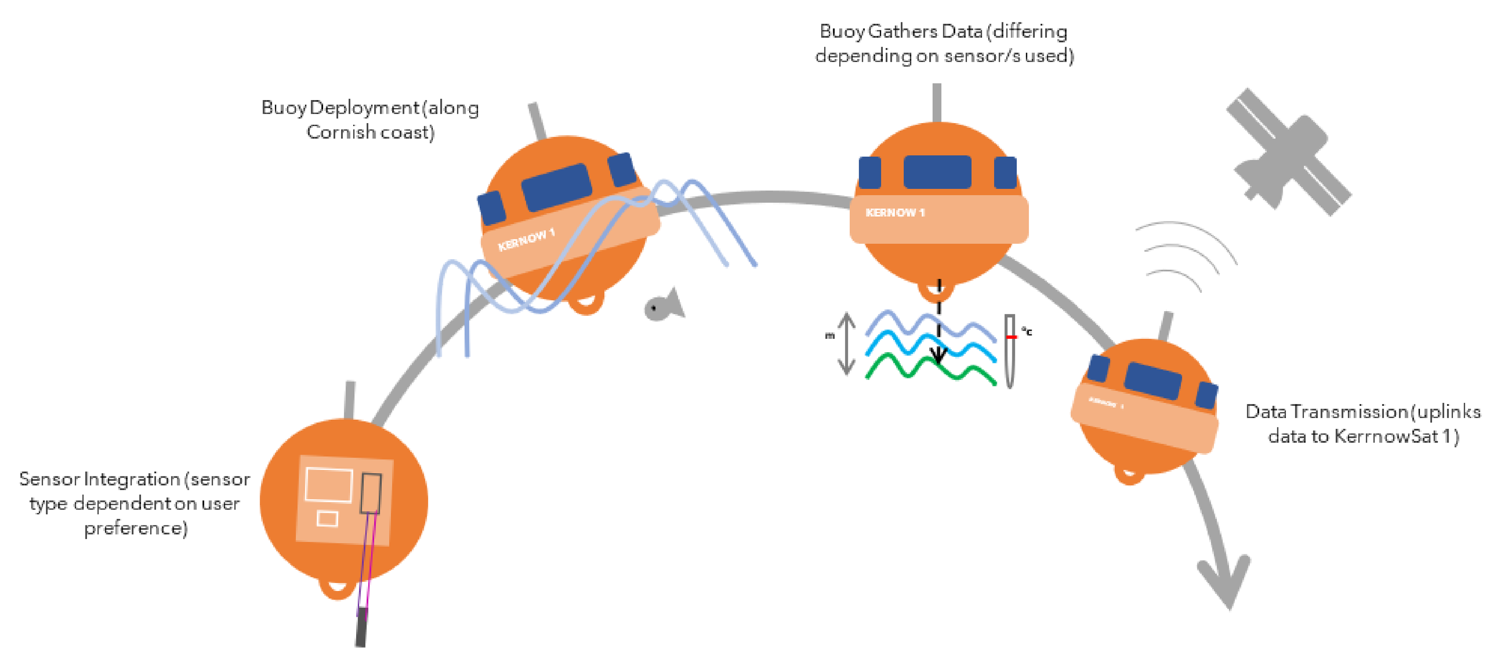
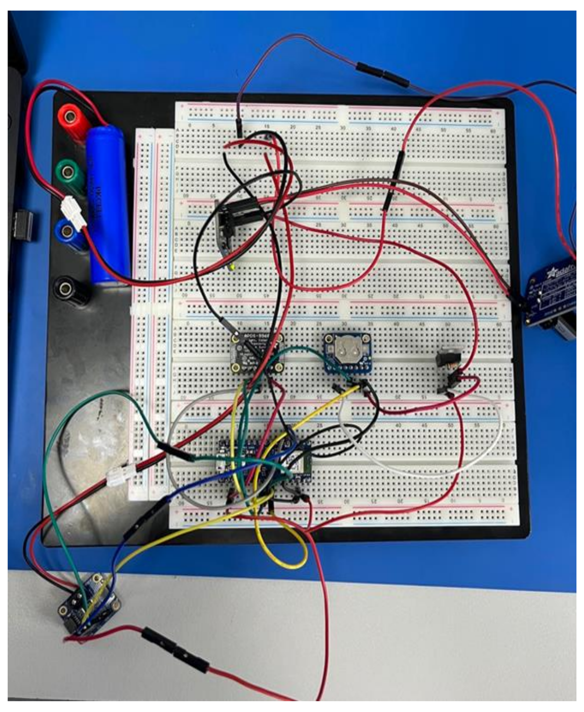
Background and Objectives→

- This project is based around buoy design as part of the KernowSat-1 mission.
- In line with the Cornwall Council climate action plan, the KernowSat mission aims to gather data about the costal ocean environment in Cornwall by monitoring environmental indicators in the sea, measured by the data buoy and transmitted to the orbiting satellite, KernowSat-1.
- The main scope of the project was therefore to identify and define the main parts of the buoy and put each of the systems together to test their function and gradually integrate them to build a complete system.
- The mission also aims to create greater interest in space amongst people in Cornwall which is why the buoy has been designed and documented in such a way that the user can choose the type of sensors they want to implement and therefore the type of data they want to gather
- This can include sensor data such as water temperature, wave height, water colour etc.
- The data gathered can then be used by companies or educational settings, as well as a way to identify the best areas for kelp farming to promote carbon sequestration in the ocean.
- Some of the documentation can also be used for outreach to local schools and universities.

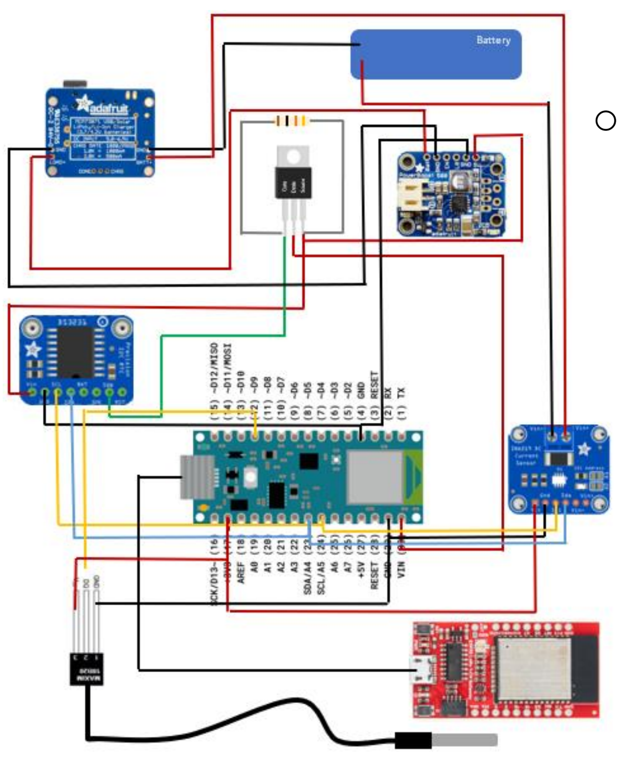


KernowSat Buoy Mission CONOPS

System Setup and Testing→



Power Monitoring & RTC Setup

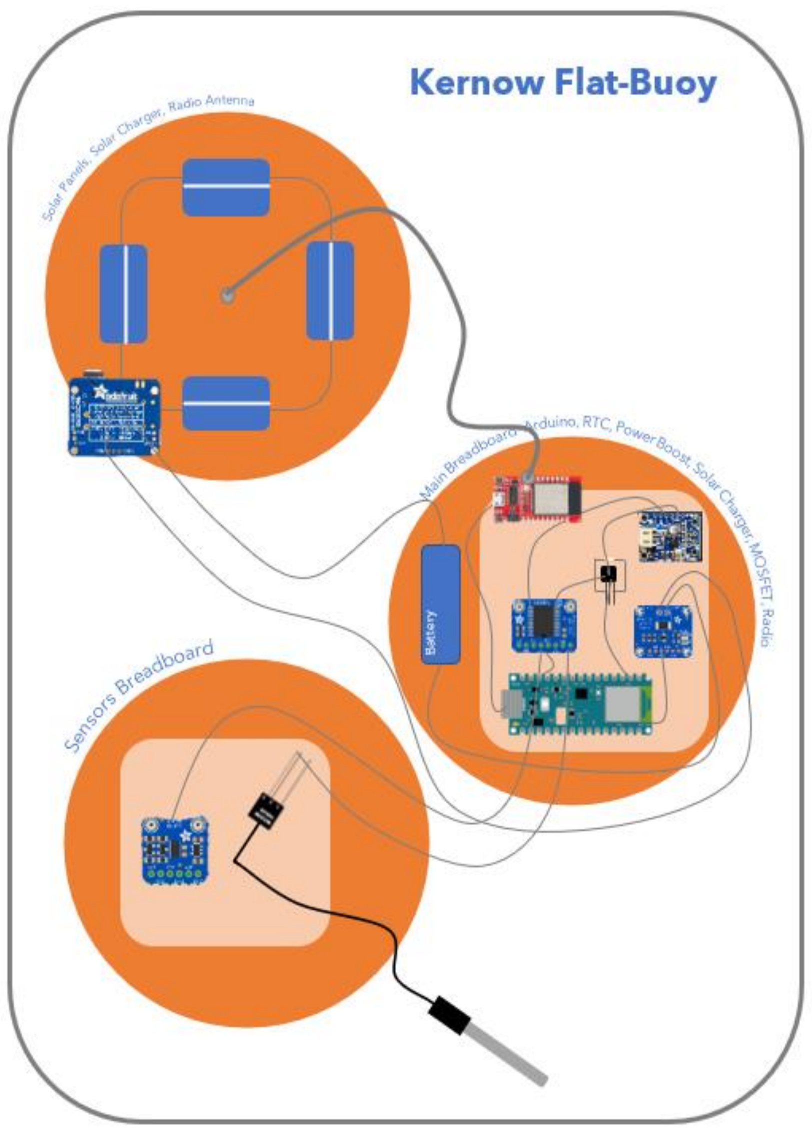


Full System Wiring Diagram

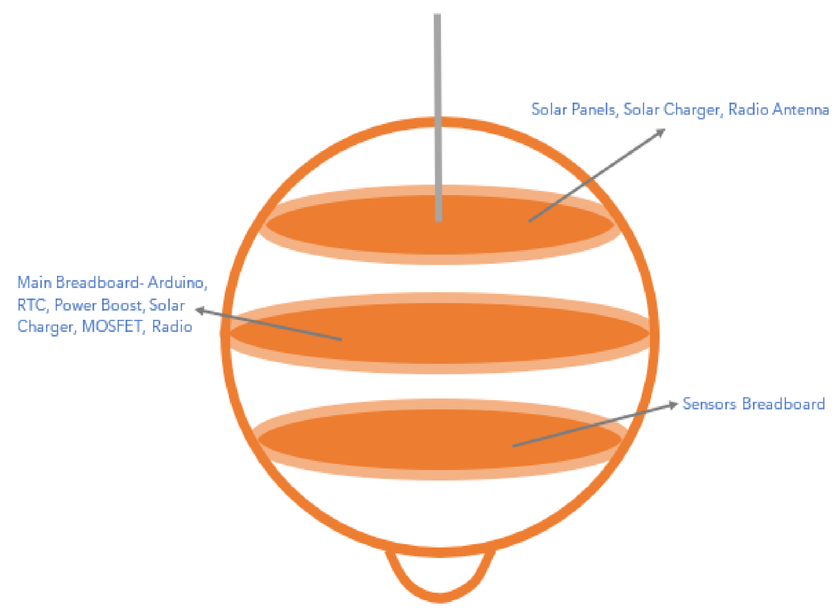
- The buoy system is made up of separate subsystems that work in conjunction to fulfil the operational requirements.
- The majority of the project was spent looking at how these different subsystems could be set up, programmed, and tested individually, before integrating them into a complete system.
- Each setup was made gradually more complex to ensure that any problems could be spotted and resolved immediately.
- The subsystems were as follows:
  - Power monitoring system
  - Real Time Clock (RTC) and alarm
  - Sensor systems
  - Radio transmitter
- Setting up the systems involved figuring out at which point a test needed to take place and what that test is designed to achieve, programming and testing it, and resolving issues as they came up until the output was as expected.
- A full, working system setup was determined. In this setup, the power monitoring system works alongside the RTC to deliver power to the system, based on an alarm. Depending on the voltage output of the battery, the alarm will trigger the MOSFET to switch power off to the Arduino for a predetermined amount of time (the lower the voltage the longer the wait time). This means that, between sensor readings, power can be recovered so that the buoy can last the night which is a concern as the buoy is solely solar powered. Once sensor readings are taken, the data can be uplinked via radio to the satellite.
- A document has been written to be more student centered and act as a comprehensive guide of how to sequentially build the buoy system.

In-Buoy/'Flat-Buoy' Layout→

- There were also considerations made for how the system would be laid out inside the buoy casing and how that could be demonstrated using what has been named a 'flat-buoy' where, similar to a flat-sat, the system can be laid out in 2D to illustrate the makeup of the system and how it works.
- A diagram showing how this would look on the flat-buoy was created. It includes cross sections of the buoy containing the components that would be housed on each layer, according to their purpose within the system and where they could be placed to optimise the layout.
- A side view diagram has also been created which better represents how this would look inside the buoy and clarifies the position of each layer, relative to one another.



Flat-Buoy Layout Diagram



Buoy Layout Side View

What Will I Take Away From This Project?→

- A broader understanding of satellite technology, specifically the applications of small satellites to environmental monitoring.
- How to use the Arduino and how to write code for Arduino.
- Knowledge of a range of electronic component functions and how these work together to create an integrated, working system, as well as how to physically wire up components.
- Better adaptability; being able to apply familiar processes to an unfamiliar problem in order to find a solution and being able to change plans according to a changing situation.
- Better communication skills; being able to articulate what I am doing and why and being able to present work to both a technical and non-technical audience.
- An understanding of how what is taught in education applies to real life applications , and how an engineering project is run in a professional setting.

Acknowledgments→

- I would like to say a big thank you to the team at KISPE who have supported me throughout the project and made my experience such a positive and valuable one, and to Spaceport Cornwall for providing me with this amazing opportunity.