Abstract

SHARC Buoy

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In recognition of the growing importance of the role played by Antarctic Ocean-Atmospheric Processes as a responder to global climate events, this project initiated the design and development of an autonomous system for in-situ monitoring of the antarctic climate. The goal of this project was to design a first-generation, autonomous sensing platform while this thesis focused on developing the firmware for the system. The device will provide data on the life cycle of Sea Ice in the Marginal Ice Zone.Current research focuses on developing models for Sea Ice Interaction in the Marginal Ice Zone where phenomenon such as Waves in Ice is, as of yet, unexplained. Key measurements contributing to this phenomenon are Significant Wave Height, Environmental Temperature and Pressure, and Sea Ice Drift. Technology has played a prominent role in global climate science. Sea Gliders and Ocean buoys have seen extensive use in developing bio-geo-chemical Models in Antarctica. These devices are stationed in regions too dangerous to station humans

The project started with the identification of a set of user requirements generated through engagements with key project stakeholders. The buoy was required to survive the antarctic climate and survive off limited infrastructure. The device also had to contain a Global Positioning System to record global coordinates, a temperature sensor, digital barometer and Inertial Measurement Unit to measure waves in ice. The device was built with a portable power source supplied by commercial-grade batteries in series with a temperature-resistant Low Dropout Regulator, and a power sensor to monitor the module. A satellite modem was added to transmit data remotely through a reliable satellite network. Finally, flash chips were used to store data permanently. Code was developed in C for the STM32l4 micro-controller with custom API libraries developed for each electronic module. An algorithmic state machine was implemented to sequence various sensor events. The sensors were uninitialised when not used and turned off with the processor put into deep sleep mode to optimise the firmware for low power consumption.

Full system tests were performed by running the buoy in an open field and continuously monitoring the transmissions. Due to the COVID 19 pandemic, final testing of the system could not take place in Antarctica.The device successfully demonstrates a proof of concept that, through further testing and power optimisation, can bridge the technological divide.