BlueChip Technology

CASE STUDY

Sound Waves and Ocean Waves – embedded board used in North Atlantic Research

Background

Blue Chip Technology computers travel all over the world, bringing the power of the processor to locations as diverse as factories, hospitals, airports, power plants and test laboratories. However, submerged under the North Atlantic Ocean proved a very unusual destination for one Magnum X single board computer.

Current climate change models are incredibly complex entities, pulling in data from the world's weather and ecosystems. One area under close study is the exchange of gases between the ocean and atmosphere. Bubbles formed by breaking ocean waves are a key element of this exchange but better understanding of these bubble formations is needed to generate more accurate climate models.

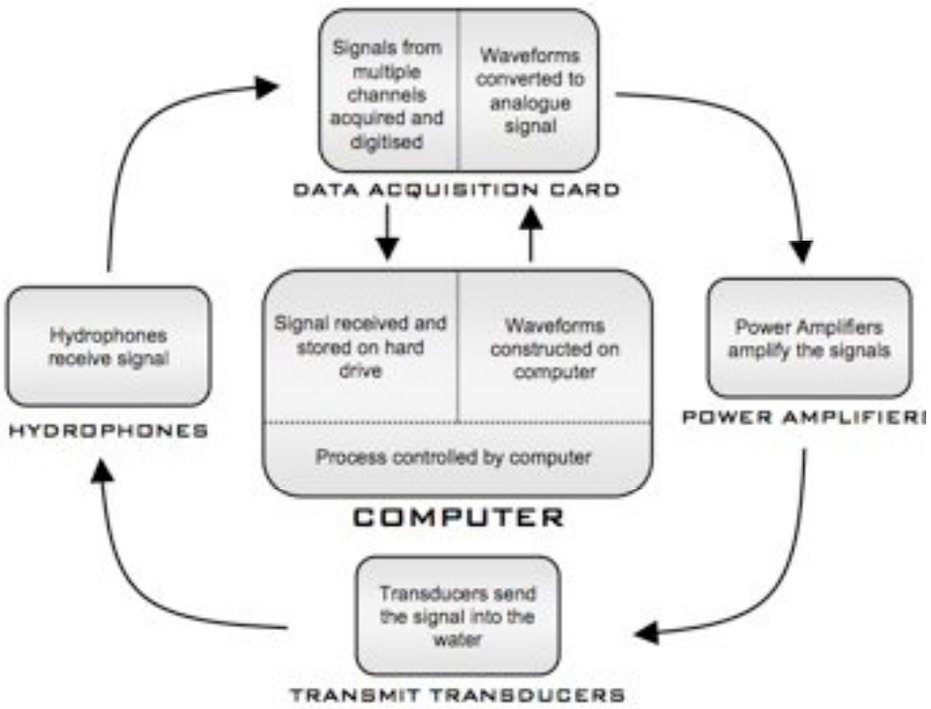
As part of the Surface Ocean Lower Atmosphere Study (SOLAS), the Natural Environment Research Council (NERC) funded a project to design and execute an experiment to measure bubble populations in the North Atlantic using an acoustic system mounted on a spar buoy. The project was led by the Southampton University Institute for Sound and Vibration Research (ISVR).

The Application

The spar buoy was to be able to float freely, away from the ship, and be left for a number of days before it was recovered. This immediately ruled out the possibility of having a cable running from the ship to the buoy in order to control it. This left two potential methods of control. The first would be to have a wireless transmitter and receiver installed on the buoy. This could be used to control the equipment and also send data back to the ship as it was received. There are two factors that make this method unsuitable. The first is the extra power it would take to power the transmission. Since the system is likely to be limited by the battery life, the amount of unnecessary power consumption must be as low as possible. The second factor is the range of the wireless system. It was likely that the ship would have to leave the area the buoy was deployed in and there are very few wireless systems with great enough range to cope with this.

The second method would be for the acoustic system to be entirely autonomous and control itself, meaning an onboard computer controller with the buoy construction. The acoustic system needed to be capable of :

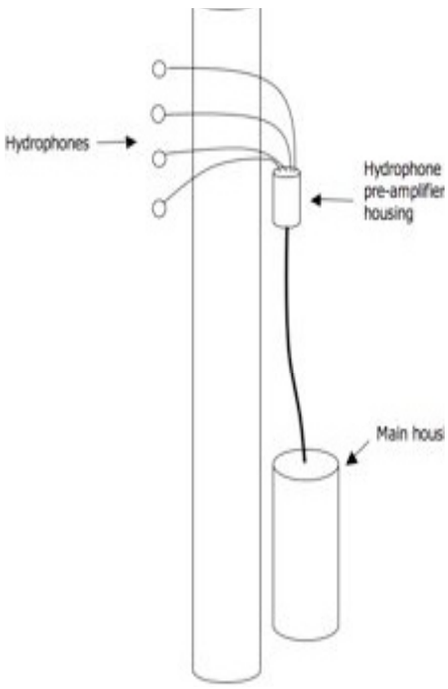
- Constructing acoustic waveforms
- Transmitting these waveforms into the water
- Receiving and recording the waveforms
- Storing the recorded data
- Controlling the entire process



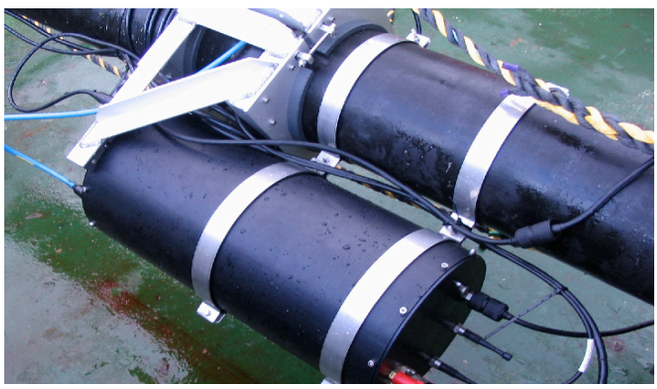
The Solution

It soon became clear that a special computer was called for and ISVR began to look for a solution from the embedded world. David Cole, Project Leader, was initially considering using a PC104 board – the established benchmark in small footprint embedded boards. However, the Magnum X board from Blue Chip Technology had the special appeal of a neat 115mm x 145mm footprint coupled with a comprehensive array of IO, designed with full connector interfaces.

There was already an established body of research in this area including programming examples for attenuating waveform data from bubble insonification. David further developed this analytical process using Windows XP and Matlab – it was important to be directly transfer the programming to the embedded computer without any adaptations. The actual data analysis was performed once the buoy was returned to the research ship and the data was downloaded. However, the Magnum X was configured with a 1GHz processor, fast enough to process a real-time data rate of 1 million samples per second, across 4 channels. The standard IO connectors proved invaluable in quickly accessing the data once the buoy was brought back aboard the buoy – " we just plugged in the mouse, keyboard etc and could pretty much run the unit like a normal desktop," commented David Cole. Storage consisted of a 2.5" IDE hard drive, meeting space and budget requirements.



The system hydrophones and transducer power amplifiers where already drawing a lot of power, the 100Watt power consumption would have further complicated the power management and decreased the active data gathering period of the buoy. With a typical 12 Watt consumption, the Magnum proved perfect for the unit and also ran from a single 5V power input, simplifying power conversion.



The Magnum X controller, data IO board and other circuitry was housed in a pressure sealed, waterproof tubular unit. At 3ft, the housing needed to be custom-engineered for the project - the most expensive element of the project, "using an embedded board kept the overall size down, a larger board would have meant a larger housing unit and exploding costs." explained Dave Coles

And so, the Magnum X found itself bobbing 8 metres under the North Atlantic in November 2006, and after four deployments, the data gathered proved the buoy was the first fully autonomous acoustic system capable of measuring bubble populations in deep ocean. A second research cruise is planned for July 2007, when ISVR will increase the multiplexing capability within the system increasing the potential amount of data recovered. The whole project is an excellent illustration of Blue Chip Technology's Magnum X hitting a sweet spot in performance, size and power, truly exploiting the benefits of embedded computers over land, sea and foam.

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