The Doppler Effect, Oceanic Colonization, and the need for Software Defined Networking Solutions for Examining Waterways Contamination: Underwater Wireless Networks

Andrew M. K. Nassief[1]

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Abstract

Due to the Doppler effect in waves, one can't efficiently transmit signals underwater. This paper takes you to novel approaches that utilize sonar conversion techniques as well as different UART communication methods and software defined networking mechanisms, in order to build underwater wireless networks. The case for UWNs being utilized for oceanic colonization is also presented, as well as how this applies to the creation of "Aquatic IOT type technologies" and new forms of telemetry. Presented in this paper are concepts that were deployed by the Stark Drones Corporation in competing for various challenges such as "The Internet of H2O Challenge" and GigabitDCx. Also presented, is a proposal to apply these technologies for monitoring lake contamination and various forms of e-coli buildup as well as phosphorus run-ons. These networks allow for a cleaner, more sustainable and observable ocean.

Please note: This articles is part of my submission to the Ocean Observing Prize

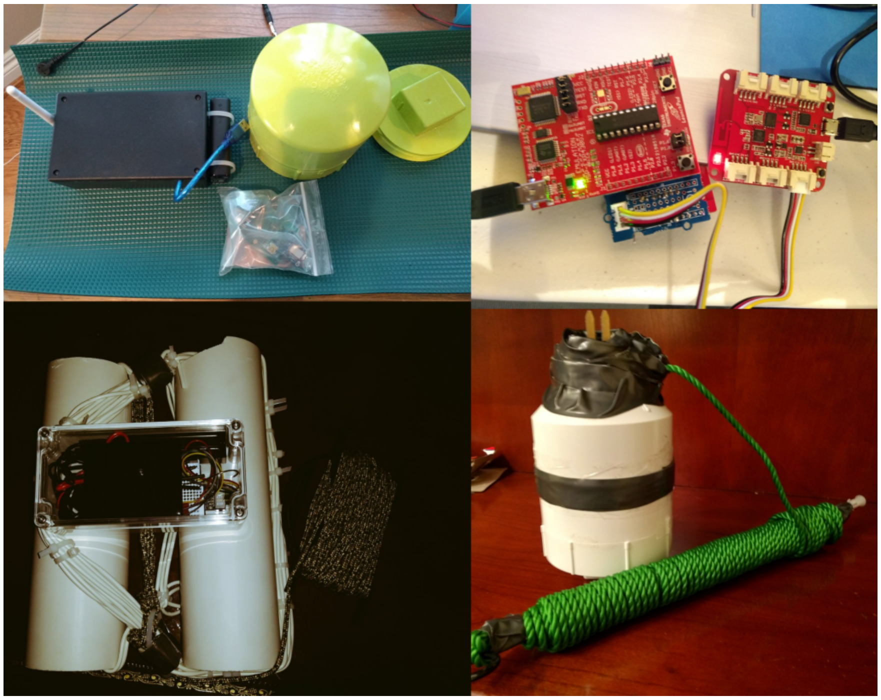

Figure 1: Original Prototypes and parts of Underwater Wifi Project

$f' = (N + v_o T/\Lambda)/T = N/T + v_o/\Lambda.$

The equation seen above describes the Doppler effect with water waves. A layman terms example, of an observer where the frequency of the waves is changed, is somebody is paddling a boat (*The Doppler Effect - Physclips waves and sound*, n.d.). This makes the wave become distorted. Due the the fact that barometric pressure changes underwater, wind frequency, buoyancy and other factors, one will always have a distorted underwater wave frequency. This prevents you from utilizing traditional wireless communication mechanisms.

Mission Statement

> "We can help provide valuable information about our oceans w/ a noiseless signal"(*Ocean Colonization*, n.d.)

Monitoring Approach + Original Pitch

We collected data utilizing real-time software defined networks. Compared to YSI's model 6600 v2 and other sensory networks, we use more efficient and less technological infrastructure, making us much cheaper. Our sensors can even replace biochemical testing as well. Beach water testing methods or approaches that take experimentation and over 24 hours to get data are no longer a problem. We are replacing over $30k+ worth of equipment with cost efficient devices. Our sensory modules include the following: Moisture and PH reader (Model 1), (Optical and Nano-Sensory (Model 2), and we have a P2P Connection module (Peer 2 Peer or Point 2 Point) that allows the extension of our wireless reaches. We can help predict when we would need to do nutrient offloading or monitor chlorophyll A using Model 2's optical sensory system or Spectrophotometry.

First Deployment

https://raw.githubusercontent.com/Mentors4EDU/Images/master/W.png

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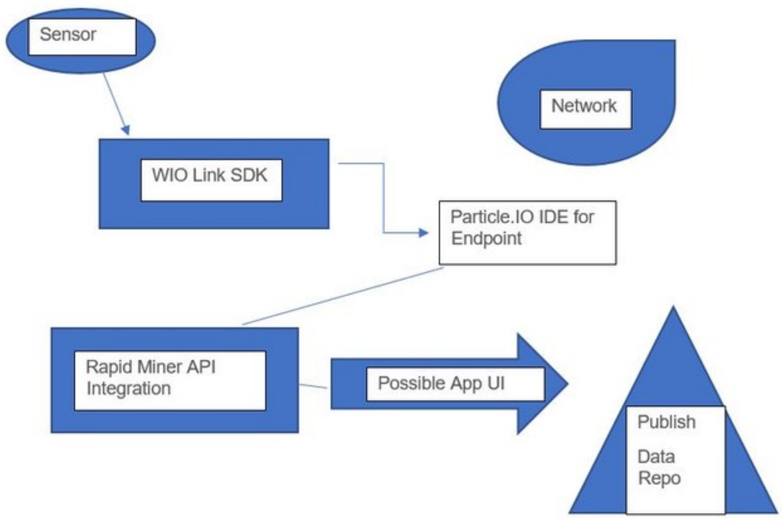

Figure 2: Data Sync Method

Currently the first version of the prototype involved signal conversion. What I utilized for my first prototype was: a Wio-Link dev kit, an Optical Biosensor, sonar sensor, PHAT IOT shield, a MSP430G TI dev board, and soldered a custom converter. The Devpost for the first variation of this sensory project is (*Reinvent the Internet*, n.d.). This data syndication method is also one of the development software packages that is part of the (*decentralized-internet*, n.d.).

Version 2.0

http://img.youtube.com/vi/fFobli9n9E8/0.jpg

The second version involved a whole different enclosure and built in data logger. The conversion method and software was also quite different. We relied solely more on spectrometry for the sensory mechanism and utilized the wavelength extension module (Sonar conversion) and data logging. We didn't need any WIO Link or Particle Dev boards for v2, and sort of built our own sensitivity tip. Version 2 also relied on off the shelf software and its expansion even went a step further.

Figure 3: 2nd Version Test Deployment Data Logging Buoy

Figure 4: Banner

A further module of v2, may be the implementation of some sort of underwater telemetry system i.e. “underwater telecom tower”.

Figure 5: Proposed Enclosure Part (Pre-Coating)

Technologies such as underwater wireless network communications can lead to oceanic colonization. One isn’t just making oceans cleaner by utilizing wireless observatory networks, but one can also make it more accessible. A futurist may say that underwater wifi can lead to underwater cities, and intercommunicated tunnel networks. Perhaps exploring the ocean may be easier than exploring space.

Ecological Importance

Figure 6: Nasa: (*Toxic Algae in Lake Erie*, n.d.)

Toxic Algae buildups, phosphorus run-ons, and e-coli buildup are destroying our waterways. The ability to be able to observe what is going on quicker and more efficiently is a huge part of fixing the problem. This is why these wireless networks are an efficient mechanism for garnishing info throughout real-time noiseless signals.

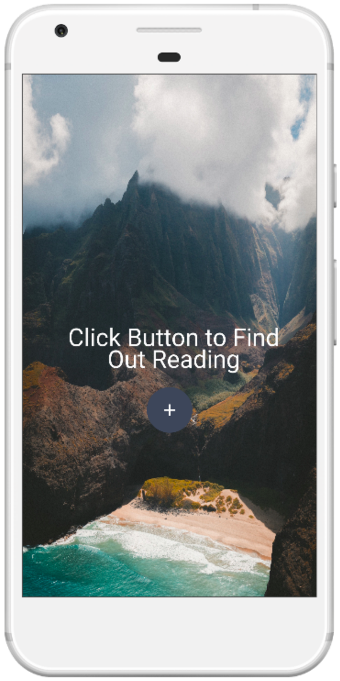

Figure 7: UI/Mockup v1 Variation

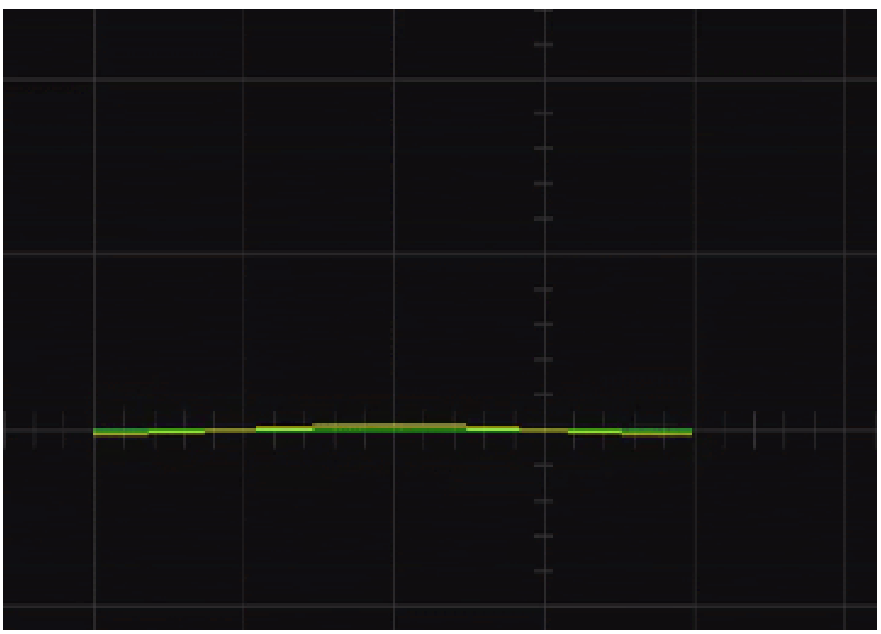

Figure 8: Please click

Conclusion

Utilizing advanced sensory techniques and new modern day communication protocols such as sonar signaling, the decentralized-internet protocol, and UART communication modules one will be able to create a series of different software defined underwater wireless networks or UWNs. These advancements in telemetry would be efficient in the real-time monitoring of waterways and can help us track important information regarding contamination in our oceans. These technologies also introduce AOT or AIOT type technologies (Aquatic Internet of Things) that can likely lead to a more sophisticated and complex ocean.

References

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