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SEEBLIK

UNDERWATER OPTICAL COMMUNICATION SYSTEM

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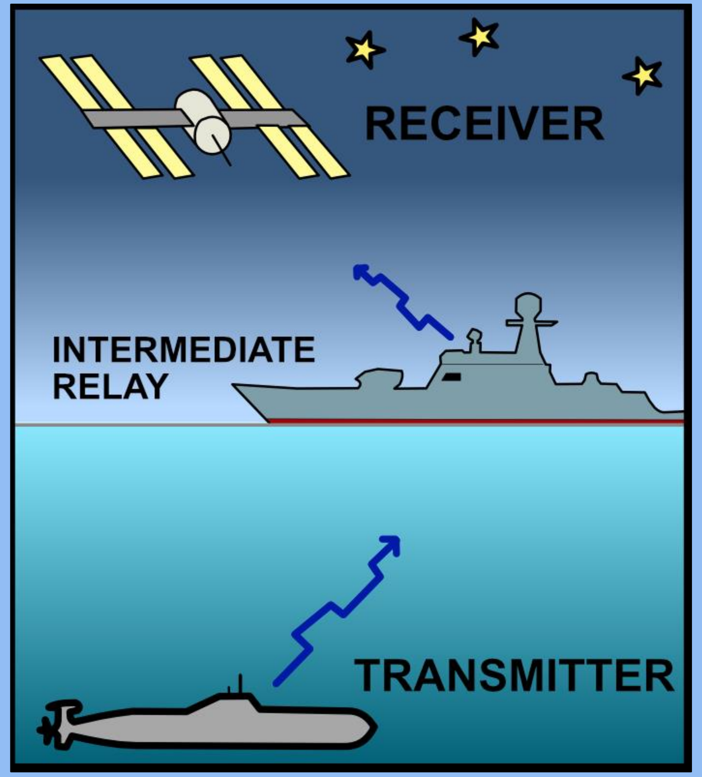
Product Description

SeeBlik is an optical communication system that can transmit data on a laser beam through various optical channels (open air and underwater). Information such as text can be sent wirelessly. SeeBlik's purpose is to provide high speed underwater communication.

Motivation & Purpose

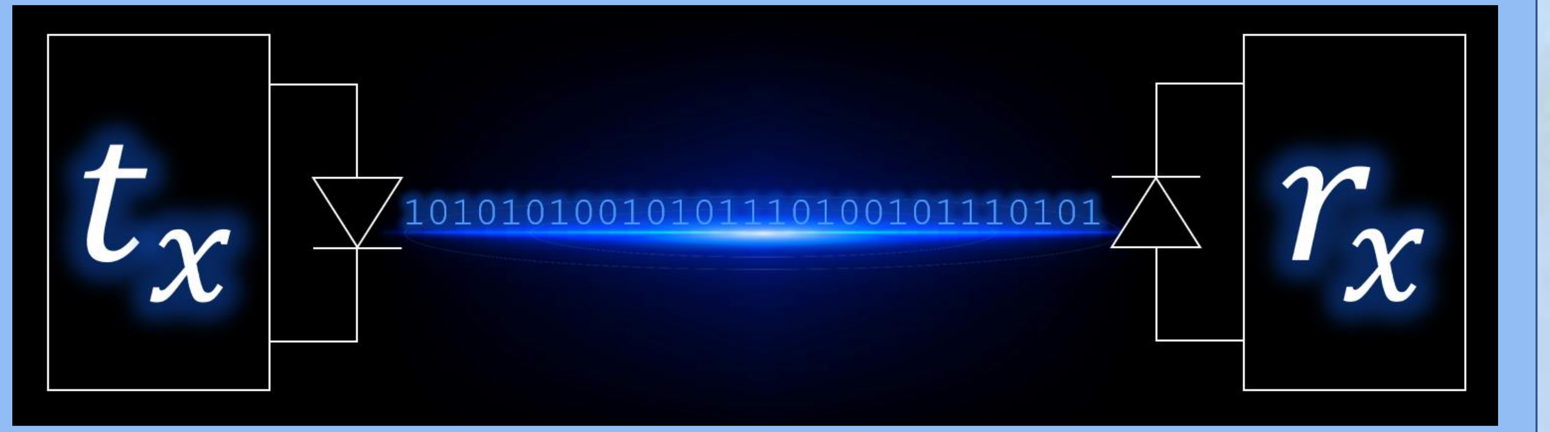
Our product seeks to provide high-speed wireless communication underwater. Today, two main methods exist: VLF (Very Low Frequency) RF communication and communication by wire. These solutions are not ideal because either the data transfer rate is extremely slow (300 bits per second), or it restricts mobility. SeeBlik seeks to solve the issue of wireless high-speed underwater communication by creating a high-speed underwater optical communication system. Our product will provide an ability that government agencies, militaries, and marine companies need. They would benefit from a product that gives them the ability to communicate underwater at high speeds.



An Example of SeeBlik Application:
A submarine may communicate by SeeBlik to a ship. The ship may then serve as an intermediate relay to an orbiting satellite.

Design

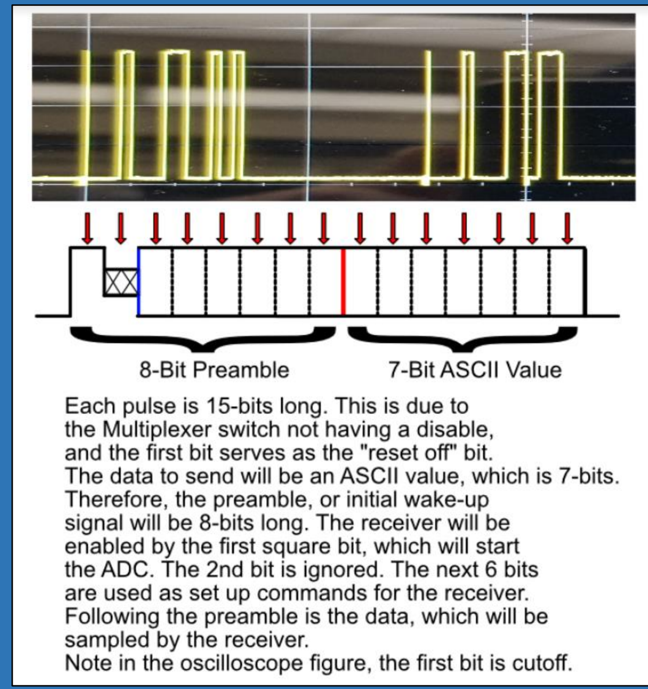
SeeBlik consists of two essential components: a laser transmitter and an optical receiver. The transmitter contains a microcontroller that encodes data onto a modulated blue (450nm) laser beam. A photodetector, in the receiver, will then receive the optical signal. The received signal will then be decoded by a microcontroller. SeeBlik will provide data transfer rates into the tens of thousands of bits per second.



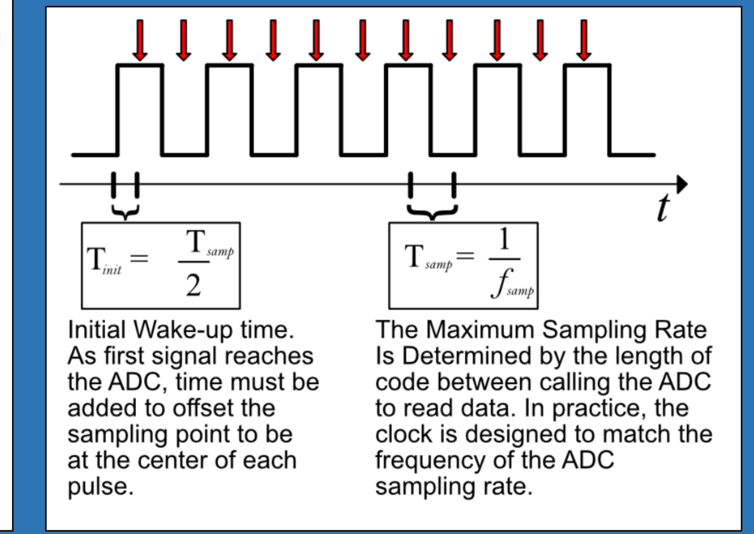
Block Diagram of the Communication System: Transmitter, t_x, sending optical serial data to the receiver, r_x.

Software

The transmitter controller receives a user-inputted word which is stored in memory and waits for the user to enable the system. Once enabled, the inputted word is dissected into individual characters, the first character is translated into a 15-bit array and preloaded into a multiplexor. The transmitter then enables a counter to send each individual bit to the receiver, where the receiver samples the 15-bit array and stores it as an individual character. The process is repeated until the transmitter sends a "PRINT" code, which the receiver uses to print the received data to a COM terminal.



Word Being Sent



How The Sampling Rate Is Calculated

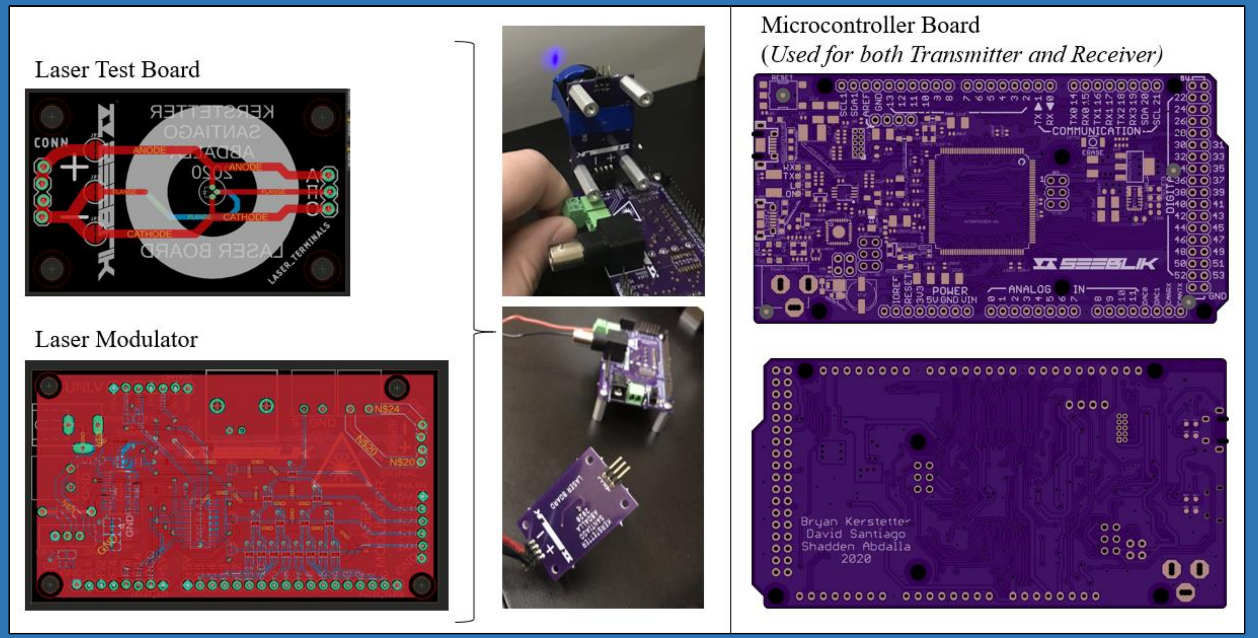
Hardware

Transmitter

The goal of the transmitter is to encode data to be sent and then modulate a laser diode. A microcontroller receives the data and then loads the parallel data into a 15-bit word. This parallel data is then converted into a serial data string of ones and zeros. The serial data becomes the input to a laser driver that then drives the laser diode to turn on and off.

Receiver

The laser diode creates a modulated laser beam that propagates through the communication channel. The light from the laser beam hits a photodiode. The varying light intensity is then converted to an electrical signal. This electrical signal is then recorded by a microcontroller and the data is outputted.



Cost Analysis

The total amount spent on this design project is $2488.74. The cost can be broken down into three categories: optics, printed circuit boards, and printed circuit board components. The optics were the most expensive, at $1320.74 because of the cost of the lasers, Fresnel lens, and three pairs of safety glasses. The printed circuit board components cost $1028.60. The printed circuit boards cost $139.40. A single system can be built for $200.

The cost of the project is reasonable for the targeted customers: defense contractors, maritime companies, and government agencies. It can be anticipated that when the product is mass produced, the cost will go down because of lower cost of bulk purchasing. The cost of safety equipment can also be factored out.

Conclusion & Future Plans

In practice, SeeBlik has been able to transmit data between the transmitter and receiver. The final device, the laser module, was necessary in order to make the underwater communication work, however, due to the 2019 Novel Coronavirus Disease (COVID-19) Pandemic, social distancing, and federal and state regulations, the laser module and other small details have not been able to be completely fabricated and tested.

Future plans for SeeBlik are to completely refine and polish each module and to be able to establish long distance optical communication. With increased funding and time, the laser module may be improved where the laser can be a Class IV (500mW or greater) laser and would provide much longer and effective distance communication in all kinds of mediums such as deep underwater or space communication. The microcontroller terminal system may also be improved to be integrated with data collection software and user-friendly capabilities.