Marine Aquaculture Sensor Network Based On Sinusoidal Current Signal

Akbar Taufiqurrahman, Man Hee Lee[ᴮ], Soo Young Shin*

akbartaufiq@kumoh.ac.kr, lmh910420@kumoh.ac.kr[ᴮ], wdragon@kumoh.ac.kr*

Department of IT Convergence engineering
Kumoh National Institute of Technology

Abstract

This paper proposes a marine aquaculture sensor network, utilizing a sinusoidal current signal as its data communication foundation. Deploying wireless connections underwater poses significant challenges and costs compared to land-based setups. In the realm of wired communication, a greater number of devices is necessary to manage numerous sensors simultaneously. To tackle this, the system model utilizes a traditional power line to integrate sensor data. This approach facilitates the use of a single microcontroller to manage multiple sensors concurrently beneath the water. In this system, a mix of various frequencies in the sinusoidal current signal is merged and sent via the power line from the transmitter. Upon reception, the Fast Fourier Transform (FFT) is utilized to distinguish between frequency bins, which are used to identify the source of the sensor data. The magnitude of each bin represents the actual sensor data.

Keywords : Sensor, marine aquaculture, microcontroller, sinusoidal current signal.

I. Introduction

Currently, marine aquaculture stands as a promising farming option, particularly due to its environmentally friendly and sustainable nature [1]. However, unlike land-based aquaculture, marine farming presents more challenges in environmental monitoring. Firstly, implementing a wireless sensor network underwater is arduous and much more challenging. Researchers have increasingly focused on underwater wireless communication, acknowledging its distinct challenges compared to land-based wired or wireless connections. This medium poses difficulties due to its limited transmission rates over short distances using complex transceivers. Additionally, the marine environment possesses unique characteristics that set it apart from the atmosphere, where conventional terrestrial communication takes place. Consequently, underwater monitoring necessitates a wired monitoring system. Secondly, monitoring vast sections of large fish cages requires numerous sensors.

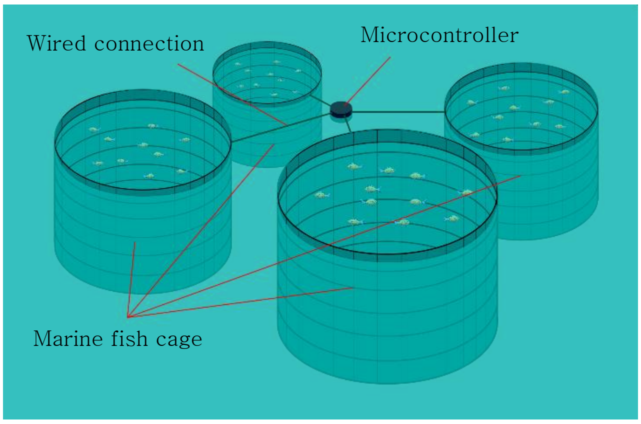

Fig. 1 Marine Aquaculture Sensor Network.

If the microcontroller used has limited input pins, multiple microcontrollers become necessary to handle all the sensors. Therefore, this paper proposes utilizing sinusoidal current signals [3] as the data transfer method from sensors to microcontrollers. Furthermore, the prevalent use of multiple homogeneous sensors simultaneously in the marine aquaculture setting serves as the motivation for proposing this method.

II. Proposed System

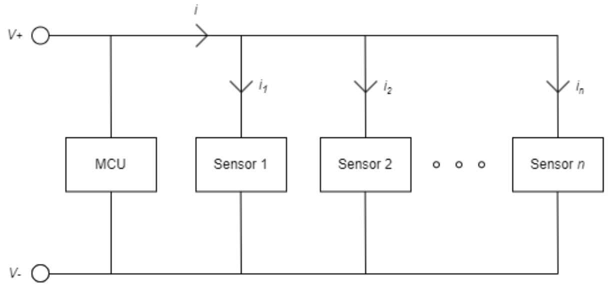

Fig. 2 System Model [3].

This paper proposes a monitoring system for homogeneous multi-sensors in the marine aquaculture environment, employing a method utilized in [3]. This method utilizes sinusoidal current signals to transfer sensor data through a power line. As depicted in Figure 2, the system structure consists of: first, a microcontroller equipped with an amplifier and a sensor that receives sinusoidal current signals from the power line; second, a number of n sensors within the fish cage, each equipped with a low-capacity microcontroller functioning as a generator for sinusoidal current signals. Both are interconnected via a parallel power line.

Similar to the approach taken in [3], each sensor will possess its unique address in the form of different frequencies. This allows the microcontroller to discern the origin of incoming data from specific sensors. Subsequently, the sensor data transmission occurs in voltage amplitude format. These two signals are amalgamated into a sinusoidal current signal received by the microcontroller, which processes it using Fast Fourier Transform (FFT). Through this process, the microcontroller obtains the address data of each sensor in the form of frequency and the sensor data itself in voltage amplitude. As depicted in Figure 1, this method enables the use of a single microcontroller to manage multiple sensors within a fish cage. Furthermore, a single microcontroller is capable of receiving data from multiple sensors across more than one fish cage simultaneously.

III. Conclusion and Future Work

This paper addresses the challenge faced by homogeneous multi-sensor setups in marine aquaculture, where conducting multiple data transmissions simultaneously proves difficult due to the complexity of implementing wireless communication. Meanwhile, employing wired communication necessitates a larger number of devices to manage multiple sensors concurrently. Hence, the method of transmitting data via a power line in the form of sinusoidal current signals is employed, theoretically enabling the use of just one microcontroller to handle n sensors at once. For future endeavors, this concept will be implemented and tested in a real-world environment to assess its reliability and functionality.

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