Available online at www.sciencedirect.com

ScienceDirect

Procedia Computer Science 124 (2017) 698–705

Procedia Computer Science

www.elsevier.com/locate/procedia

4th Information Systems International Conference 2017, ISICO 2017, 6-8 November 2017, Bali, Indonesia

# Design and Implementation of Real-Time Mobile-based Water Temperature Monitoring System

Paul B. Bokingkito Jr.[a]*, Orven E. Llantos[b]

[a]*Mindanao State University – Buug, Datu Panas, Buug, Zamboanga Sibugay 7009, Philippines*
[b]*Mindanao State University – Iligan Institute of Technology, Tibanga, Iligan City 9200, Philippines*

**Abstract**

In this age of international trade and competition, the aquaculture industry needs to plan and implement a technology that will address issues concerning global food security. In modern aquaculture management, a remote water quality monitoring and computer-controlled intensive culture is the future trend in aquaculture. The objective of this research is to design and develop a real-time mobile-based water temperature monitoring system capable of decreasing the reliance on manpower at the monitoring site to reduce the cost and to assess fish production cycle and fish grow-out system. The system implementation resulted in a monitoring system that collects the current water temperature from the core-controller in real-time. Also, the system provides and displays information that includes normal range, maximum, minimum, average and findings of the collected temperatures. The results obtained in this study has shown the ability of data acquisition in the remote and real-time detection of water temperature accurately and efficiently. It provides decision support to help and guide fisher folks in avoiding distress to fish and obtaining the optimum water temperature range.


Peer-review under responsibility of the scientific committee of the 4th Information Systems International Conference 2017.

*Keywords:* water temperature monitoring; cloud computing; fog computing; RESTful API; mobile; IOT

* Corresponding author. Tel.: +0-000-000-0000 ; fax: +0-000-000-0000 .
*E-mail address:* paulbokingkito@gmail.com

1877-0509 
Peer-review under responsibility of the scientific committee of the 4th Information Systems International Conference 2017
10.1016/j.procs.2017.12.207

## 1. Introduction

Aquaculture in the Philippines contributes significantly to the country's food security, employment, and foreign exchange generation. Aquaculture is growing much faster than capture fisheries. However, according to the Fisheries and Aquaculture Department of the Food and Agriculture Organization of the United Nations, the global position of the Philippines in aquaculture production has fallen steadily from 4th place in 1985 to 12th place today [1]. The Philippines now contributes only a little over one percent of global farmed fish production compared to five percent previously [2].

In Lake Sebu, Southern Philippines, several cases of catastrophic massive fish kill has been reported in 2016 and in February 2017 that caused up to 50 tons of fish went to waste leading to an increased in prices of Tilapia as a result of lack of supply [3, 4, 5]. The sudden changes in the weather and temperature affecting water quality are the cause of the fish kill. Thus, the incident disclosed the Bureau of Fisheries and Aquatic Resources to monitor the water quality of the lake.

Water quality monitoring plays an important role in aquaculture to ensure sustainable good water quality [6]. In several studies on the development of water quality monitoring system, the temperature is considered as one of the significant water parameter [7, 8].Water temperature has an important part in determining the distribution of aquatic organisms, physicochemical water characteristics, and rates of ecological processes such as nutrient cycling [9]. Also, water temperature is a key water quality variable because it influences all other water quality parameters such as dissolved oxygen concentrations [10].

In this age of international trade and increasing global population, the aquaculture industry needs to plan and implement a technology that will address issues concerning global food security [11]. In modern aquaculture management, a remote water quality monitoring and computer-controlled intensive culture is the future trend in aquaculture [12]. Water quality monitoring determines the goodness of water for specific purposes. The water quality tests give information about the health of the water resources.

One of the technological revolutions of computing and communications is the Internet of Things (IoT). It is a smart interconnected device that sense, interpret and react to the environment due to the combination of the internet and embedded sensors system [13, 14]. The challenged for this emerging technology is how to craft a system that collects and monitors water temperature of a water resource in real-time.

The objective of this study is to design and develop an efficient and cost effective real-time mobile-based water temperature monitoring system that could aid the aquaculture farmers in the improvement of the aquaculture industry. The Representational State Transfer (REST) architectural design is used to connect and collects real-time water temperature that consists sensor and core-controller, database server and RESTful APIs.

In general, the system could provide information that includes normal range, maximum, minimum, average and findings of the collected temperatures that provide decision support to help and guide fisher folks in avoiding distress to fish and obtaining the optimum water temperature range. Also, the system could display the water temperature being monitored continuously in real time directly to the stakeholders' mobile devices and collects long-term of data.

## 2. Methodology

### *2.1. Requirements Elicitation*

#### *2.1.1. Tools and Instruments*

In this study, the main instruments for the water temperature monitoring are determined. Primarily, the chosen main components, the core controller and temperature node are the Raspberry Pi 3 Model B and DS18B20 Digital Temperature respectively as shown in Fig. 1. Raspberry Pi is run on LINUX kernel by the use of keyboard and monitors wherein LINUX OS specifically Raspbian is booted onto the Raspberry Pi [14]. The waterproof DS18B20 Digital temperature sensor is used to detect the water temperature. The DS18B20 Digital Temperature provides 9 to