ISSN 2347 - 3983
Volume 8. No. 7, July 2020
International Journal of Emerging Trends in Engineering Research
Available Online at http://www.warse.org/IJETER/static/pdf/file/ijeter96872020.pdf
https://doi.org/10.30534/ijeter/2020/96872020

Tilapia Fishpond Monitoring System with Fishkill Prevention

Michelle M. Caranguian[1], Bienvenido B. Abad Jr.[2], Edward B. Panganiban[3]
[1]AMA Computer College, Santiago City, Isabela, Philippines, esonmichiemar@gmail.com
[2]IBSUniversity, Port Moresby Papua New Guinea, bbajr1981@gmail.com
[3]Isabela State University, Echague, Isabela, Philippines, ebpanganiban@isu.edu.ph

ABSTRACT
Since the world is evolving and technology have become rampant, there are still improvements or reforms about the monitoring system in fish farms. This study titled “Tilapia Fishpond Monitoring System with Fishkill Prevention” will modernize the current system of fish farming. One of the major concerns in the fish farming industry is the fish kill problem. Fishkill refers to the die-off of fish populations which occurs when the water of the pond is in bad condition or if it lacks oxygen. That is why the researchers focus on this matter to improve the ways the old system is using to prevent this from happening. This paper includes the conceptualization of a microcontroller-based system for the prevention of fish kills. It uses sensors that will automatically detect the characteristics of water as to its water temperature, humidity, and ph level. The pH meter sensor is used to trigger the probiotic dispenser. The water temperature sensor is used to turn on the water pump. If the water temperature is at the threshold level, the buzzer will turn on. It also includes a night light when sunlight is not available. It is embedded with an email notification feature to inform the owner or the caretaker of the fish farm about its status. At the end of the study, the researchers find out that the system works properly based on the evaluation of experimental testing conducted.

Key words: Tilapia, Fish Farming, Monitoring System, Microcontroller, Sensors, Fishkill

1. INTRODUCTION

Fisheries contribute significantly to the country’s food security. Since ancient times fisheries help hundreds of millions of people to have a source of food, income, and livelihood. Aquaculture presently accounts for a significant portion of the Philippine total fish harvest. Fish is the principal animal protein source for Isabela's rural population. Nevertheless, the market growth for full-capita fish production is deteriorating. Fish aquaculture here in the Philippines is falling behind the lines of other countries' aquaculture. That’s why we need to improve the strength of our market and reduce the farming risks for the Philippine aquaculture to survive.

In developing countries, fish farms are now being marketed. They offer family farms with a food source and profits from the selling of fish, and can also provide animal irrigation requirements and water. Tilapia is also one of the sources of livelihood in Isabela. One of the major problems concerning fishpond aquaculture is insufficient fish harvest due to the impending heat which is caused by the drought season. The Philippines only has two major weather seasons, which are the summer and rainy seasons. When summer hits water loses much of its ability to hold oxygen. Also if the pond is hot and fairly humid the water may evaporate losing water in the pond. Drought season had become one of the major concerns that the local fishpond aquaculture is facing.

Fish die from a great range of environmental and abnormal causes. Fish can die of hunger, suffocation, old age, body injury, toxic algae, extreme weather, anxiety, water contamination, infections, pests, predation, and other causes [1]. "Fishes, shrimps, crabs, eels adrift along the Pampanga River" these are just some of the reports here in our nation regarding fish killing. This occurrence, usually faced by fishermen seeking freshwater and marine fish farming, was unexpectedly exposed to an unprecedented degree that it left us wondering what happened and why it occurred [2].

One of the problems also includes, not having enough or no proper equipment to check on the water of the pond. In a certain study, the issues encountered by the managers of these fish ponds involve the need to feed the fish regularly, track the quality of the water and adjust the water when the condition is unsafe for the fish [3].

In this system of globalization trading and competitiveness, the fisheries sector needs to prepare and introduce a technology to tackle global food security issues [4]. Mostly with advancements in machines like Arduino [5], Raspberry pi [6], the advancement achieves ground level with its formulation in agriculture and aquaculture [7]. Designers use different types of sensors in a recent paper, such as the temperature, pH value, and level detectors. All the task is streamlined by using these sensors and it will also be useful to track fish production wirelessly from other places [8]. Another paper established a set of mobile aquaculture surveillance system which not only can track the dissolved oxygen, temperature, pH value and level metrics of the ponds in real-time, but also track the fish status in real-time using a wireless camera. [9]. The DO, pH, temperature, and water levels are calculated in another project and incorporated with aerating and water system motors utilizing Arduino as its microcontroller [10].

By addressing these concerns, this project aims to develop the traditional way of fishpond aquaculture by injecting innovative and new technologies such as sensors [11]. This project aims to improve the checking of water temperature with the help of a DS18B20 or water temperature sensor. It also checks the ph level of the water with the use of ph meter sensor, this sensor checks the acidity of water. It also monitors the moisture and air temperature by using DHT11/DHT22 which is a humidity sensor. Through the help of NodeMcU, this helps the design project to communicate to the internet which gives the user the power to monitor the fishpond and control it remotely with an android phone. It also uses an alert system in case of internet interruption or if there are no possible internet connection.

2. MATERIALS AND METHODS

2.1 General System Design

This paper's general concept is explained using figure 1. All these figures are system architectures that illustrate the features of the tilapia fishpond with the prevention of fishkills.tilapia fishpond monitoring system with fishkill prevention. Figure 1 is the diagram of the navigation function of the tilapia fishpond monitoring system with fishkill prevention. When the tilapia fishpond monitoring system with fishkill prevention is on, the sensors will automatically detect the characteristics of water. The design project will then send signals to connected android phones. The user can control the probiotic dispenser and can also turn on the water pump.

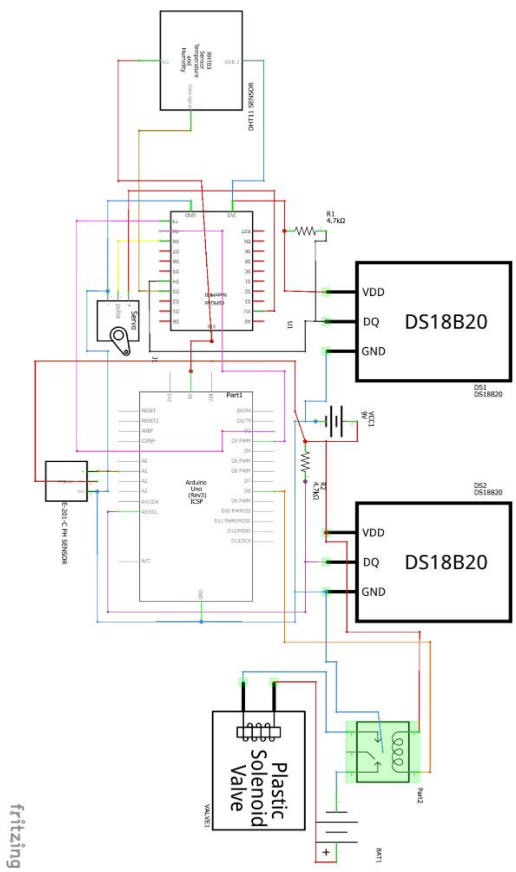


Figure 1: System Architecture of the tilapia fishpond monitoring system with fishkill prevention

2.2 System Flowchart

Figure 2 demonstrates the comprehensive function of controlling the tilapia fishpond network with the prevention of fishkills. It describes how the system works, step-by-step operation. It is equipped with sensors that can detect 4 major inputs including water temperature, pH meter, humidity, and area. The pH meter sensor sends a signal to the microcontroller for the user to trigger the probiotic dispenser. The water temperature sensor sends a signal to the microcontroller to the user for the user to turn on the water pump. If the water temperature is in critical condition or the water temperature is higher than 30 degrees the buzzer will turn on. We also include a night light which turns on once the LDR detects that the sunlight is gone which then turns off once there is no one in the area for 30 seconds and will turn on if it detects someone or a thing with the use of motion sensor.

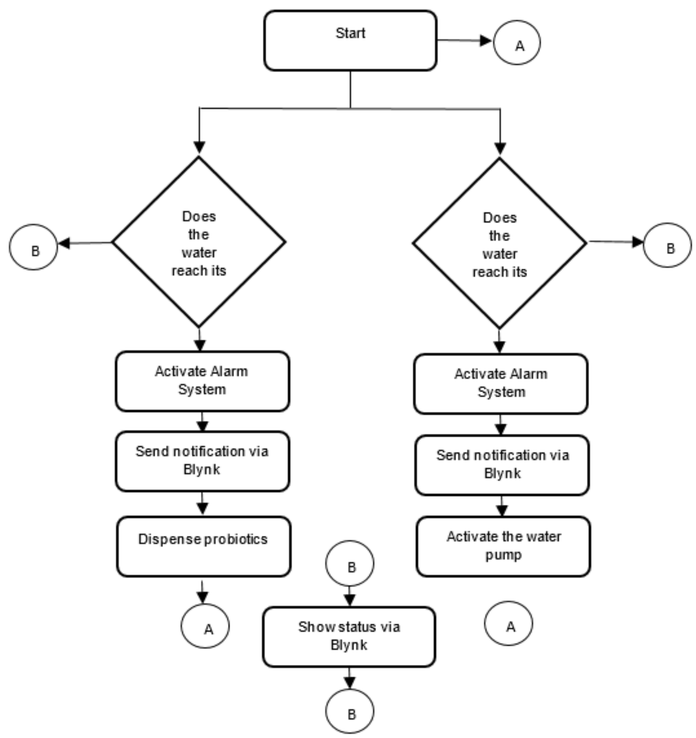


Figure 2: System Flowchart

2.3 Wiring Systems

The circuitry wiring diagram is shown in Figure 3. This shows each of the materials used for the proposal as a reference when communicating. The main device being used is the Arduino Uno microcontroller [12] which serves as the brain of all the connected components. The water temperature sensor, pH meter sensor, humidity sensor, and area temperature sensor acts as the input sensors that control different actions and trigger other hardware like probiotics dispenser which will throw probiotic fertilizer to the water, light system when it is midnight, water pump to add water to the pond and buzzer which serves as the alarm.

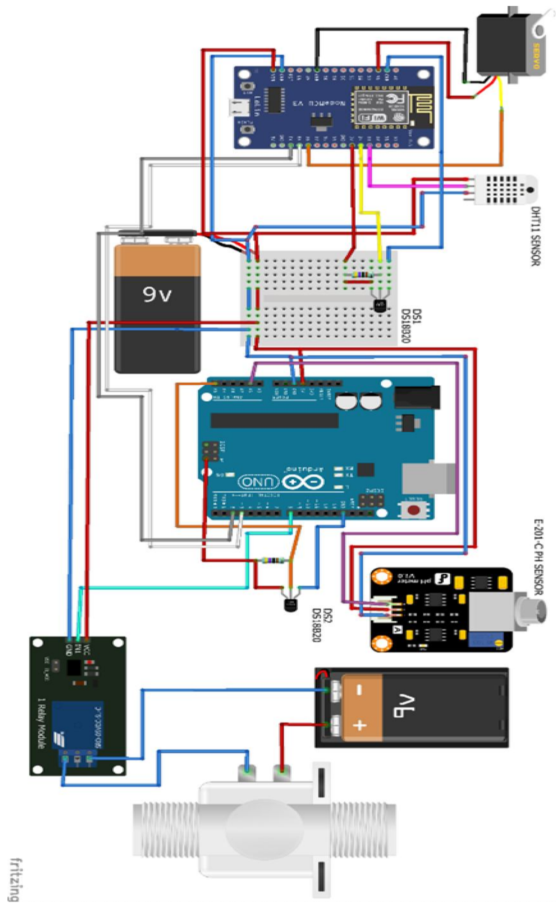


Figure 3: Wiring Diagram

3 RESULTS AND DISCUSSION

One essential step in developing this paper is checking the prototype or the robot's functionalities. To arrive at a desirable output it was put into several tests. Evaluations involve unit testing, acceptance testing, as well as integration testing. Unit testing was performed to simulate all of the components utilized and to ensure that they all operate. Acceptance and integration testing ensured that everything was working according to its goals. Thorough tests showing the robot 's integrity were presented in the specified next tables.

3.1 Results of Testing

Table 1 shows the water temperature and water pump testing. It shows the responses of water temperature and water pump once the water temperature reached a certain limit. The table shows that when the water temperature had detected 30 degrees or more the alarm system will turn on and will send an email notification through the Blynk app via an android phone.

Table 1: Water temperature sensor, Alarm, and email notification

Trial	Water temperature Sensor (DS18B20)	Detection	Alarm	Email Notification	Water Pump
1	36^{o} - 37^{o}	YES	ON	Email Received	ON
2	35^{o} - 36^{o}	YES	ON	Email Received	ON
3	34^{o} - 35^{o}	YES	ON	Email Received	ON
4	32^{o} - 33^{o}	YES	ON	Email Received	ON
5	30^{o} - 32^{o}	YES	ON	Email Received	ON
6	29^{o} - 27^{o}	YES	OFF	Email Received	OFF
7	26^{o} - 24^{o}	YES	OFF	Email Received	OFF
8	23^{o} - 20^{o}	YES	OFF	Email Received	OFF
9	19^{o} -16^{o}	YES	OFF	Email Received	OFF
10	15^{o} -10^{o}	YES	OFF	Email Received	OFF

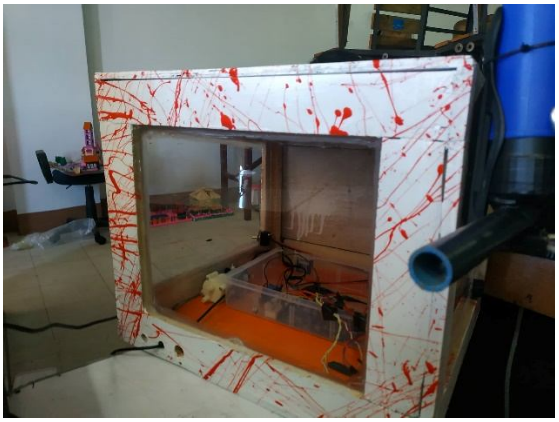
Table 2 shows the pH sensor and probiotic dispenser testing. The table shows that when the pH level reached the optimal pH level of the water it will not activate the probiotic dispenser. The table shows that when the pH sensor reached 5 pH level to 1 pH level it means that the water is in bad condition and the probiotic will need to be turned on. So as 10 and above the amount of pH level.

Table 2: pH meter sensor and probiotic dispenser

Trial	pH sensor	Detection	Email Notification	Probiotic Dispenser
1	10.01-11.0	YES	Email Received	ON
2	9.01-10.0	YES	Email Received	ON
3	8.01-9.0	YES	Email Received	OFF
4	7.01-8.0	YES	Email Received	OFF
5	6.01-7.0	YES	Email Received	OFF
6	5.01-6.00	YES	Email Received	ON
7	4.01-5.00	YES	Email Received	ON
8	3.01-4.00	YES	Email Received	ON
9	2.01-3.00	YES	Email Received	ON
10	1.01-2.00	YES	Email Received	ON

3.2 Design Output

Figure 4 shows the final design output of the tilapia fishpond monitoring system with fishkill prevention. You can see the components used in the design project such as Arduino UNO, node MCU, etc. It also includes the wirings of the design project.



(a)

(b)

Figure 4: Final design output of the tilapia fishpond monitoring system with fishkill prevention. (a) front view (b) rear view

4 CONCLUSION

This study sets out the details of the overall prototype structure as well as the descriptions of the research data indicating the prototype's desired outputs. The materials included in this proposal comprise sensors that could detect water temperature, pH level, humidity, and area temperature. It is built with a probiotic dispenser and water pump which can be controlled by the user. The buzzer was designed and built as an alert system alarm indicator. Blynk app will automatically give the individual a message via email.

The project was made possible through the designed processes and proven working with its intended function to address the household's problem in fishpond farming. The researchers concluded that this project is working and is proven to be effective as evidence by the several tests done. Hence, the tilapia fishpond monitoring system with fishkill prevention can be of help preventing fishkill.

Acknowledgment

The authors would like to give special thanks to Arvin Jay Samaniego, John Balicao, John Raymon Macalib-og, and Keyzel Jane Valdez B. for the construction of the prototype and their assistance for this paper to become successful.

REFERENCES

[1] L. A. Helfrich, "**Fish Kills : Their Causes and Prevention**," *Virginia Cooperative Extension*, pp. 1–4, 2009.

[2] J. N. Carpio *et al.*, "**A cost-effective fish pond monitoring and warning system using thermal probe**," *International Journal of Simulation: Systems, Science and Technology*, vol. 19, no. 3, pp. 14.1-14.4, 2018.

[3] F. E. Idachaba, J. O. Olowoleni, A. E. Ibhaze, and O. O. Oni, "**IoT enabled real-time fishpond management system**," *Lecture Notes in Engineering and Computer Science*, vol. 1, pp. 42–46, 2017.

[4] P. B. Bokingkito and O. E. Llantos, "**Design and Implementation of Real-Time Mobile-based Water Temperature Monitoring System**," *Procedia Computer Science*, pp. 698–705, 2017. https://doi.org/10.1016/j.procs.2017.12.207

[5] E. B. Panganiban and J. C. Dela Cruz, "**RFID-Based Vehicle Monitoring System**," in *HNICEM 2017 - 9th International Conference on Humanoid, Nanotechnology, Information Technology, Communication, and Control, Environment and Management*, 2017, pp. 1–6. https://doi.org/10.1109/HNICEM.2017.8269489

[6] E. B. Panganiban and J. C. D. Cruz, "**Rainwater level information with flood warning system using flat clustering predictive technique**," in *IEEE Region 10 Annual International Conference, Proceedings/TENCON*, 2017, vol. 2017-Decem.

[7] S. Saha, R. H. Rajib, and S. Kabir, "**IoT Based Automated Fish Farm Aquaculture Monitoring System**," *2018 International Conference on Innovations in Science, Engineering and Technology, ICISET 2018*, pp. 201–206, 2018.

[8] J. Janet, S. Balakrishnan, and S. S. Rani, "**IOT Based Fishery Management System**," *International Journal of Oceans and Oceanography*, vol. Volume 13, no. 1, pp. 147–152, 2019.

[9] L. J. Xu, N. Wang, Y. Feng, D. N. Bao, and K. Jorshin, "**Design of aquaculture system based on wireless monitoring and its testing,**" *International Journal of Interactive Mobile Technologies*, vol. 10, no. 5, pp. 68–73, 2014. https://doi.org/10.3991/ijoe.v10i5.4035

[10] Z. Harun, E. Reda, and H. Hashim, "**Real-time fish**

pond monitoring and automation using Arduino," *IOP Conference Series: Materials Science and Engineering*, p. 12, 2018.

[11] E. B. Panganiban, "**Automated hazardous gas detecting robot using wireless sensor networks with GSM-SMS alert and fire control system for households**," *International Journal of Advanced Trends in Computer Science and Engineering*, vol. 8, no. 3, pp. 804–809, 2019. https://doi.org/10.30534/ijatcse/2019/72832019

[12] E. B. Panganiban, "**Microcontroller-based Wearable Blood Pressure Monitoring Device with GPS and SMS Feature through Mobile App**," *International Journal of Emerging Trends in Engineering Research*, vol. 7, no. 6, pp. 32–35, 2019. https://doi.org/10.30534/ijeter/2019/02762019