A Mobile Application development of Automatic Shrimp Feeder System

Vivien Arief Wardhany[1,*] Herman Yuliandoko[2] Subono[2] M. Udin Harun Al Rasyid.[4] I Gede Puja Astawa.[5]

[1]*Politeknik Negeri Banyuwangi, Informatic Engineering Department, Banyuwangi, East-java, 68461, Indonesia.*
[2]*Electronic Engineering Polytechnic Institute of Surabaya, Informatic and Computer Engineering Department, Surabaya, East-Java 60111 Indonesia.*
Corresponding author. Email : vivien.wardhany@poliwangi.ac.id

ABSTRACT
Since Feeding management and water Quality Monitoring become important things to control in aiming maximizing the cultivation of shrimp. The development of the Mobile Aplication is used to support the automatic Shrimp Feeder help the farmer to control and monitor the shrimp Ponds from a distance. This Mobile-Application aims to feed the shrimp in the ponds of aquaculture system. This device using a Smartphone device based on the Android OS that connected into the Feeder and Monitoring-System, which consist of several sensors like pH, Temperature and Salinity. In this android application, system monitoring of the shrimp cultivation is using the Monitor, which feature contains the name of the pond, pH, Temperature, Dissolved Oxygen, Measurement Date, and Measurement Time and Schedule of feeding according to age of shrimp. The report features include PDF download document, monitoring charts, monitoring history features and a Control for feeder feature also with Warning Notification if some conditions happen. The conclusion is overall quality rate of the application is in good condition, with 83.9 % percentage. The highest aspect quality is the reliability with 86.6%, fucntionality aspect is 83.3% and usability aspect is 81.1%.

Keywords: *Mobile-Aplication, Android, Feeder, Monitoring-system, Sensor*

1. INTRODUCTION

In Indonesia Shrimp Farming has become livelihood for the people who live in the coastal areas for majority in east-java island specially in Banyuwangi. Shrimp is one of the commodities in the fisheries sector that can improve the economic sector of society. The high demand for shrimp from Indonesia make Indonesia become one of supplier of shrimp in the world. The Shrimp Culture System in Indonesia consists of an extensive system (traditional) and an intensive system. Most of the shrimp farmer uses the extensive system, which the ponds management depends on the natural condition. Feed management is very important in the aquaculture, one of the reason is that the cost of feed expense has a lot of value about (50-70)% from the total cost production.[1][2]
Feed management give considerable impact for the water quality and the surrounding environment. In the other hand the feed management cause 60% of the problem inside the ponds through accumulation form the organic waste. The side effect of uneaten food will be gathered at the bottom of the pond and become poisonous gas (ammonia), when oxygen levels are low and a plankton bloom occurs (suspected by the brightness of concentrated water). By observing the of feed impact, how important effective feed management in the shrimp ponds. so that feeding management must be done properly. [3]

1.1. Objective

In this research we develop a mobile application to help the farmer controlling the feeder machine that is usually operated manually by the farmer operator. Thus, the mobile application also improves the feed management in the shrimp ponds by utilize the android application that connected to the several sensors. Beside the feeding management we also provide monitoring data from the shrimp ponds like water temperature, pH and Dissolved Oxygen of the shrimp ponds. From the monitoring data we used to help the farmer maintain the condition of each shrimp ponds to give action if there is any problem in the water quality of the shrimp ponds.

1.2. Related Work

According to this research there are several works which become the reference related to this research. There are some research that has been done which help us to improve our project such as :

1.1.1. A Model of Mobile Application for automatic Fish Feeder Aquariums System

The system was designed by breaking down the procedure of measurement pH value, optimization of feeding & lighting system. The quality of water in an aquarium depends on PH value which can be used in water circulation of the aquarium. Raspberry Pi used to develop automatic fish feeding system.It used to control turn-on and turn-off the burbs in a fish aquarium based on the real time condition. The procedure was to design database and visual image on a mobile phone monitor which is linked Raspberry Pi with wireless gadgets. [4]

1.1.2. Smart Fish Feeding System for Aquaculture

The main concept of this project is to increase the job opportunity by using human controllable semi-automatic fishery feeding system, which is used for nourishing aquatic creatures in fisheries.
The system's design consists of feeding container which restrain the polymer cylindrical. It's navigates using two independent rotating turbines. The system is capable to distribute both the crystal food pellets & fluid into the fishpond. The system is controllable via wireless or cellular network. [5]
The methodology is to design a system which controls semi-automatically the pond, to keep the quality of the pond. The system designed to remotely control the feed flow rate via mobile app using nodemcu. The device is operated using solar power it is also a cover lid of the food container. Air propeller is helps the movement of the device. The four cylindrical legs are helps to float a device around the pond.

1.1.3. Fish Feeder using Internet of Things

The device is designed to integrate with internet of things, which will be help the farmers easily control the ponds everywhere, as long as they connected to the internet. It will be performed regular automatic feeding without disturbing the owners work. Using the wireless communication, the system can be set to dispatch the pellets or nutrition to feed the fish at the certain time. The Fish feeder will be automized and can be easily controlled from the mobile phone via mobile application anytime anywhere in just one click using user-friendly dashboard. [6]

2. RESEARCH METHOD

The development of automatic feeder system through this system using Grapple (Guidlines for Rapid Application Engineering method) with the purpose of being able to produce object-oriented systems in a short time without reducing the quality of the system being built. GRAPPLE is a process modeling in software development that emphasizes actions carried out at a number of stages, each stage will produce work products with object-oriented forms. [7] which consist of 5 steps as follows:

2.1. Requirement Gathering

In this step we learn the problem by reviewing the research paper which related to our work to gather information data and to develop the system. Also takes complete information from users about the system to be built by means of interviews and questionnaires. Interviews were conducted directly with users who wanted this system and with users who were directly related to the system. This stage suggests interviewing users (The Ponds Officer) who have technical abilities. Analysis of problems, functions and system requirements is included in the Requirement Gathering stage. Included in this stage are the development of data and information from the requirement gathering.

2.2. Analisys

In the analysis stage, it is done to get more information from the previous stage. This stage examines user problems and analyzes their solutions. This includes the data development and information from requirement gathering.

2.3. Design (Design and Architecture)

The design stage is carried out to design the solution to produce the analysis for the design. In this stage include: the implementation of the models and the diagrams that have been analyzed.

2.4. Development

In this step is handle by the program developer to build program code and user interface. The development of application build by using Android Studio as the Object oriented Programming. The program testing and system documentation is also done in this step.

2.5. Deployment

The deployment stage is the stage of distributing the resulting product to users. This stage includes the installation and planning of data backups when requested by the user in accordance with the previous agreement.

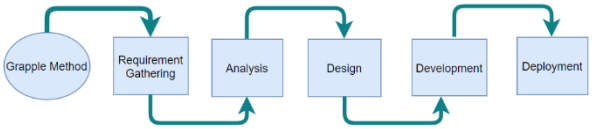

Figure 1. Grapple research Method

Every step in each grapple method is determined how the application built and works. If each system block in grapple method is not appropriate with requirement gathering and analysis, therefore the system design will not suitable with application needs. Likewise, the development step affects the deployment stage, which distributing the resulting product to users.

2.6. Automatic Shrimp Feeder System

The entire design of automatic feeder system which stand-up from several devices like temperature sensor, pH sensor, DO sensor, Arduino IDE, Arduino Uno, Feeder Valve, LED display, Buzzer and Wemos d1 mini also the Mobile application to control the device.

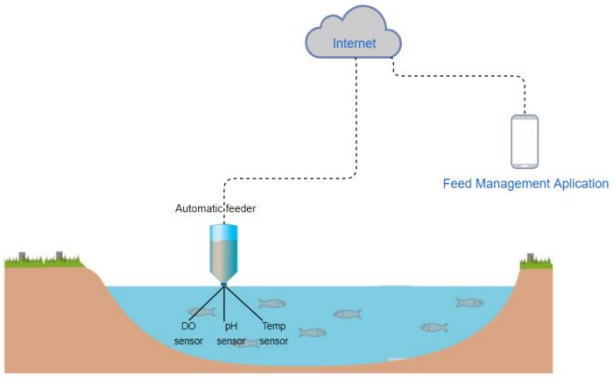

Figure 2. The Design of Automatic Shrimp Feeder

The system design proposed in this research consists of several parts, namely hardware and software, it is planned that the hardware system consists of Arduino Module, Automatic feeder and sensors, namely Dissolved Oxygen, pH and Temperature as well as an android application so that it can provide feed and simultaneously monitoring of the pond conditions at the time after feeding and when doing routine monitoring charts.

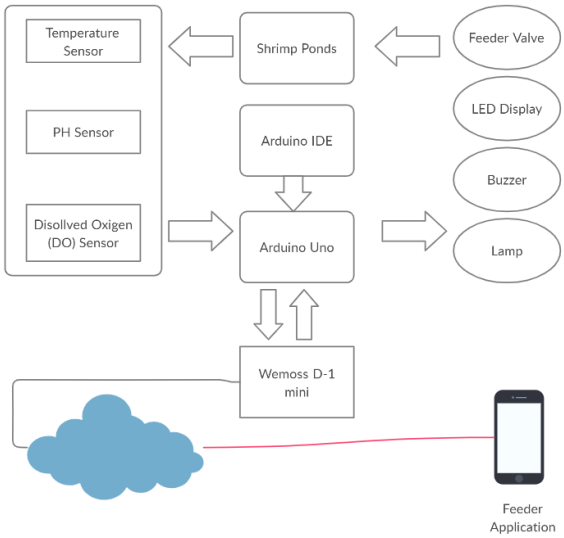

Figure 3. Architecture of Automatic Shrimp Feeder

The function of each part of the figure 3 can be described as below:

Arduino Uno, is a microcontroller module that has functions to control the performance of the device by connecting the pins of Arduino to several sensors, or other devices. [8] Sensor data processing is carried out in Arduino Uno which is installed in a white box, data read by sensors are temperature, pH and oxygen levels will be sent to Arduino and processed into monitoring

pH sensor-4502C functions as a pond pH detector to determine the acidity level of pond water for shrimp growth and conditions for feeding schedule. [9][10]

Sensors or probes connected to the pH module, the pH module has a signal pin arrangement, GND and VCC. Where VCC is the supply of voltage and using 5volt voltage, and GND is the pin that has a negative voltage.

Dissolved Oxygen sensor, functions as a detector for oxygen levels in the pond, for DO sensors there is a module connected to 3 pins signal, VCC and GND. DS18B20 temperature sensor, is a sensor that detects pond water temperature. This sensor requires a maximum power of 5 volts. To connect the temperature sensor to Arduino, the pin must be connected to the data pin of Arduino module and for a voltage of 3 volts it is obtained from the voltage source provided by Arduino Uno. [11][12]

Wemos D1 Mini is an Arduino compatible ESP8266(EX)-based board, busting out 11 digital input/output pins and a single analog input pin. The D1 board can be configured to work on Arduino environment using board manager. Wemos d1 r2, a WiFi-based module sends sensor data to a web server. In order to connect with Arduino, Wemos D1 mini requires a TX and TX connection, and a voltage of 5V.[8][13]

To connect the network between the application and hardware, we use the MQTT broker. [8] The MQTT (Message Queuing Telemetry Transport) protocol is a protocol that runs on the TCP / IP stack and has a data packet size with a small low overhead (minimum 2 bytes) so that it has an effect on the consumption of power supply which is also quite small. This protocol is a type of data-agnostic protocol which means sending any data such as binary data, text even XML or JSON and this protocol uses

a publish / subscribe model rather than a client-server model.

2.7. Feeding Management

From the survey results to shrimp farmers in Banyuwangi, we get the feeding schedule for shrimp with a variety of feed types according to the age of the shrimp with the provisions as shown in **table 1** below:

Table 1 Feeding Management according to the Fish Farm Survey

Age of Shrimp (day)	Size of Shrimp (gr)	Time Duration feeding (sec)	Feed Frequencies (per-Day)	Feeding Time
1-15	0,1 – 1	1,03 – 3,2	3	05.00 , 13.00 21.00
16 – 30	1,1 – 2,5	3,8 – 4,8	4	05.00 , 11.00 , 17.00 22.00
31 – 45	2,6 – 5,0	5,37 – 6,4	5	05.00 , 10.00 , 15.00 20.00 01.00
46 – 60	5,1- 8,0	7,03 – 7,1	5	05.00 , 10.00 , 15.00 20.00 01.00
61 – 75	8,1 – 14,0	7,82 – 8,9	5	05.00 , 10.00 , 15.00 20.00 01.00
76 – 90	14,1 – 18,0	9,72 – 6,9	5	05.00 , 10.00 , 15.00 20.00 01.00
91 – 105	18,1 – 20	12,48 – 7,69	5	05.00 , 10.00 , 15.00 20.00 dan 01.00
106 – 120	20,1 – 22,5	11, 08 – 5,76	5	05.00 , 10.00 , 15.00 20.00 dan 01.00

2.8. Fish Feeder Application Activity Diagram

Users enter feeding times schedule using the Android application. The android application stores the feed schedule input that the user inputs. After the input is stored, the android device sends user input to be stored in the database on the Arduino web server to receive commands in the database previously sent by Android. Arduino executes the instructions that have been received according to the time specified by the user. Arduino runs the feeder according to the time set by the user.

The program flow begins when the user starts running the application on an Android-based smartphone. The initial display of the dashboard is displayed on the user's smartphone screen.

Then the options appear for the feeder configuration or view pool information directly. Input from the user is needed to determine the dynamo rotation to be used on the system.

Furthermore, the dynamo rotation input will be stored in the API Database and processed by the hardware to read the pond temperature in real-time. Furthermore, the data read from the sensor will be stored in the API database, and processed by the user interface in the Android application to be displayed on the user's cellphone.

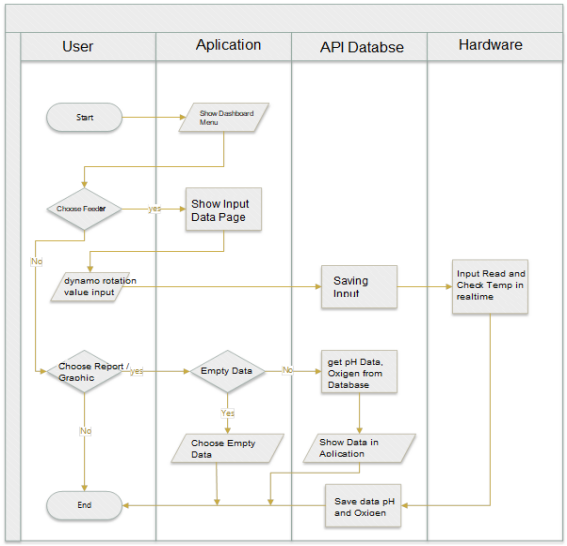

Figure 4. The Activity Diagram of Application

After all configurations have been entered, each time the user will see the quality graph report information, the application will immediately retrieve the data in the API Database and send the data directly to the user's smartphone.

2.9. Result and Discussion

This Android Feeder application contains information about pond conditions, feeding schedules, graphs of monitoring results of water conditions in the pond. This application was made to help the farmers to provide feed and monitoring.

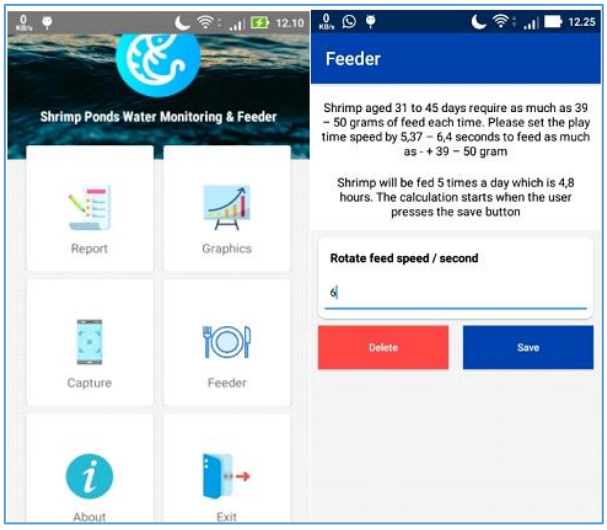

Figure 5. The Dashboad and Feeding Schedule Menu

On the Dashboard there are 6 menus available, namely: Report, Graphics, Capture, Feeder, about and exit.

- The menu report button is used to monitor the monitoring results obtained from DO, pH and temperature sensors.
- Graph Menu button is a menu to view DO, pH and temperature data presentation in graphic form.
- Capture Menu button is used to view the pool conditions.
- Feeder Menu button is used to feed shrimp according to age requirements.
- About Menu button provides information about this application.
- Menu exit button is used to exit the application.

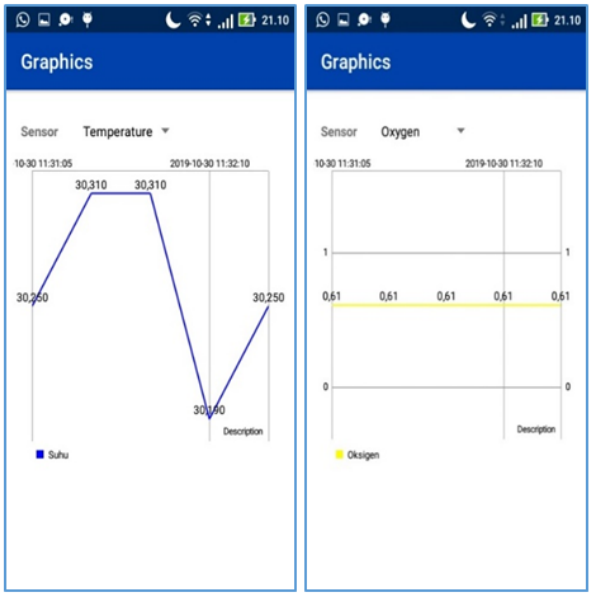

Figure 6. The Graphics Menu

The Shrimp Farmer regulates the time of feeding the shrimp which is adjusted by himself. The system will store the feeding time schedule in the database which will then control the fish feed device according to the time determined by the manager. The system will store data on temperature, time, date, time of feeding that occurred in the Shrimp farming pond and then display it in the form of history as information to the manager.

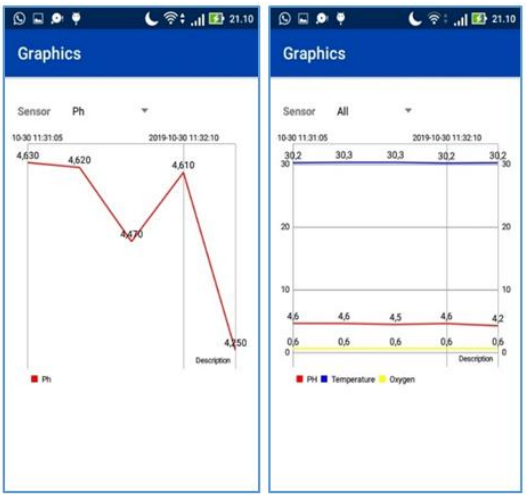

Figure 7. The Graphics of All data from The Sensors.

Figure 8. The Water Quality History.

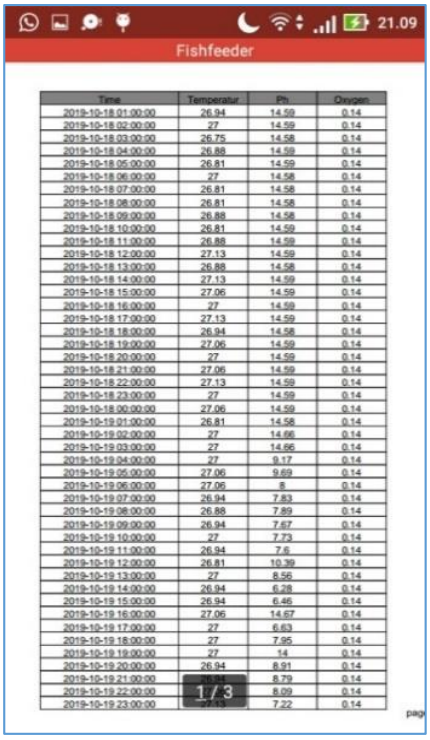

Figure 8. The PDF document from the export Data

The system will store temperature, time & date of fish feeding in the fish pond. After process by database system, the information will display information in historical table. Based on data analysis collect from questionnaire, herewith the recapitulation of quality tester based on four aspects ISO 9126.

Table 2 The Entire Software Quality Level

Aspect	Actual Score	Ideal Score	% Actual Score	Criteria
Functionality	50	60	83,3%	Good
Reliability	52	60	86,6%	Good
Usability	73	90	81,1%	Good
Efficiency	39	45	86,6%	Good
Total	214	255	83,9%	**Good**

Based on data in table 4.8, the conclusion is overall quality rate of the application is in good condition, with 83.9 % percentage. The highest aspect quality is the reliability with 86.6%, fucntionality aspect is 83.3% and usability aspect is 81.1%

3. CONCLUSION

Creating an automatic fish feeder is not a simple works in addition for adding several sensors like Dissolved Oxygen (DO), pH and Temperature to monitor the water quality is quite difficult. This project requires a lot of reading and research. this project is feasible and compact in size making it user-friendly.

With this Fish Feeder Application, pond technicians able to monitor and make decisions quickly, so that pond water quality is well maintained. The parameters that can be detected are DO, pH, and temperature. For pond owners and technicians, this application also provides a pond management system to provide more accurate information to provide a feed schedule according to water quality conditions and age of shrimp. It is hoped that this automatic feeder system can increase the productivity of the shrimp ponds.

From the all aspect of software quality level, functionality, reliability, usability, efficiency shown good criteria, which actual score valued 83.9% in total.

ACKNOWLEDGMENT

First and foremost, praises and thanks to God, the Almighty, for the shower of blessings through this research. This research was supported by DRPM Ristek Dikti 2019 in the PKPT Scheme and Politeknik Negeri Banyuwangi as supporting Institution to help this research done.

REFERENCES

[1] M. Junda, "Development of Intensive Shrimp Farming, Litopenaeus vannamei in Land-Based Ponds: Production and Management," *J. Phys. Conf. Ser.*, vol. 1028, no. 1, 2018.

[2] R. D. Rahayani and A. Gunawan, "Proposed Design of an Automatic Feeder and Aerator Systems for Shrimps Farming," *Int. J. Mater. Mech. Manuf.*, vol. 6, no. 4, pp. 277–280, 2018.

[3] R. Dileep, K. Appana, M. W. Alam, and B. Basnet, "A Novel Design of Feeder System for Aqua Culture Suitable for Shrimp Farming," no. May, 2016.

[4] D. Prangchumpol, "A Model of Mobile Application for Automatic Fish Feeder Aquariums System," *Int. J. Model. Optim.*, vol. 8, no. 5, pp. 277–280, 2018.

[5] T. Sampath, S. K. G, and R. Dhanagopal, "Smart Fish Feeding System for Aquaculture," vol. 13, no. 2, pp. 520–525, 2020.

[6] S. Meshram *et al.*, "Fish Feeder using Internet of Things," pp. 1680–1682, 2019.

[7] T. Yourself, *No Title*. .

[8] K. Karyono and H. T. N. I, "Smart Dog Feeder Design Using Wireless Communication , MQTT and Android Client," no. January 2018, 2016.

[9] E. N. S and P. D. E. N. A, "Water monitoring iot system for fish farming ponds," vol. 79, no. 2, pp. 77–79, 2018.

[10] K. GSutar and P. TPatil, "Wireless Sensor Network System to Monitor The Fish Farm," *J. Eng. Res. Appl. www.ijera.com*, vol. 3, no. 5, pp. 194–197, 2013.

[11] S. J. Yeoh, F. S. Taip, J. Endan, R. A. Talib, and M. K. Siti Mazlina, "Development of automatic feeding machine for aquaculture industry," *Pertanika J. Sci. Technol.*, vol. 18, no. 1, pp. 105–110, 2010.

[12] N. Uddin *et al.*, "Development of an automatic fish feeder," *Glob. J. Res. Eng.*, vol. 10, no. 1, pp. 27–32, 2013.

[13] S. Chaudhary, V. Bhargave, S. Kulkarni, P. Puranik, and A. Shinde, "Home Automation System Using WeMos D1 Mini," pp. 4238–4241, 2018.