

IMPLEMENTATION OF AUTOMATIC FISH FEEDING SYSTEM ON FISH CULTIVATION IN ELOY FISH SUMEDANG DISTRICT BASED ON IOT AND ANDROID

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ABSTRACT

IoT (Internet of Things) is a concept that aims to expand the benefits of continuously connected internet connectivity. IoT (Internet of Things) can be used in fish farming such as monitoring ph water and servo control via Bluetooth. The study was conducted by designing and implementing internet of things (IoT) for servo control using Arduino UNO. With this system, farmers can quickly provide food and can easily monitor the pH level of water so that they can produce fish with good quality. The process of control and monitoring is done through an android application for the operation of surveillance and control. There is one control feature which is to turn off and turn on the servo for the process of feeding fish. While the data that can be monitored is temperature and ph data. The trial was conducted by controlling the servo to monitor ph.

Keywords: IoT (Internet of Things), Arduino, Automatic Fish Feed Equipment

1. INTRODUCTION

The preferred habitat for carp is a freshwater pool that has a slow current (not too heavy), not too deep, and there is water that is thrown like a shower. Ideal water temperature and good for local carp growth between 25-30 degrees Celsius, and has acidity (PH) ranging from 7.5 to 8.5. [1]. In nature, foods that are favored by goldfish are tiny animals found around their habitat, and these fish are omnivorous, which can eat anything for their meal. But in this case, the farmers use pellet type food. This fish also has its own characteristics when he feels hungry, such as following the direction of someone who is around the pond, rising to the surface of the water, and others. Fish behavior is defined as changes in fish in the position, place, direction, and outward nature of living things that cause a difference between living ideas and their environment. The principle of fish behavior must be supported by an understanding of the primary senses of the fish (physiological organs), especially the sense of sight, smell, touch, and literal or lateral line. Bait is one of the tools that affect the attractiveness of two fish stimuli. [9].

The presence of goldfish in Sumedang can be one alternative to advance the economic community. Because the type of fish cultured from the Cyprinidae family is freshwater fish that has high economic value. Carp are grouped into two types, namely ornamental carp and consumption carp. This type of freshwater fish continues to increase from time to time. This goldfish is very popular with the people of Indonesia because the taste of carp is delicious and tasty. Also, in the body of carp contained very high protein. Usually, goldfish are consumed by frying and grilling. However, over time, carp has become one of the side dishes that can be processed with a variety of dishes. Call it Pepes, Balado, Padang, and many others. No wonder goldfish are always found in low to high-class restaurants as one of the main menus. [1]

After conducting a case study to a place of cultivation in Sumedang, researchers felt that there was something that needed to be improved from the way the farmers gave food. In addition to providing irregular feed time, farmers also sometimes do not take into account the number of fish to be fed, and the size of the pond where the fish live. Because these things can affect the fulfillment of fish food intake needs. If there are a lot of fish in the lake, then the amount of feed given must be proportional. Therefore researchers are interested in implementing an implementation of an automatic fish feed system based on fish behavior patterns whose work processes can be monitored on a smartphone in real-time, through the use of the IoT (Internet of Things) network.

2. THEORITICAL BASIS

2.1 Gold Fish

Carp (Cyprinus Carpio) is a freshwater fish that is widely cultivated by fish farmers in Indonesia. This happens because of the excellent demand for carp on the market. Starting from the lower classes to the upper classes, all are fond of this one fish. Also, goldfish also include favorite fishing animals. That is why goldfish are one of the more cultured fish produced compared to other types of fish. [1]

2.1.1 Goldfish Farming

Mr. Eloy cultivates this goldfish as a means of trade to improve the economy. The characteristics of carp are:

1. His posture is fat, upright, and somewhat elongated.
2. The movements are agile and nimble.
3. Goldfish usually have yellow, red, gold, blue, green, or a combination of these colors.
4. Adult goldfish typically have a length of 30-60 cm. And for an average weight of about 0.5 to 4 kg.

2.1.2 Fish Behavior

According to Gunarso (1985) in Fitri (2011), fish behavior is defined as fish changes in the position, place, direction, and outward nature of living things which result in a difference between living things and their environment. The principle of fish behavior must be supported by an understanding of the primary senses of the fish (physiological organs), especially the sense of sight, smell, touch, and lateral or lateral line. Bait is one of the tools that affect the attractiveness of two fish stimuli. [9]. There are several characteristics of fish behavior when feeling hungry:

1. Fish follow the direction of a person's steps when passing through the pond where he lives.
2. Fish rise above the surface of the water

2.1.3 Fish Feed

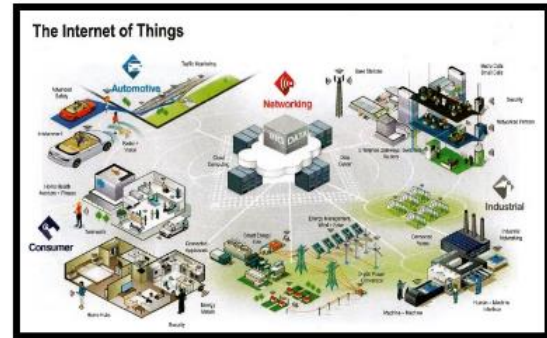
There are two types of feed for fish seeds, namely natural feed and artificial feed. Natural food is live food, including phytoplankton, zooplankton, and benthos that have been naturally available in nature, both with and without human assistance. One example of an excellent natural feed for carp seeds is *Daphnia*. *Daphnia* is zooplankton as the best natural food for the maintenance of freshwater fish seeds, and this is because the nutritional content and size of *Daphnia* are by following the mouth opening and dietary requirements of fish seeds (Herawati & Agus, 2013). Procurement of artificial feed is needed to overcome several problems of inadequate natural food. Examples of artificial feed that is often used by many farmers are pellets that are sold on the public market. Pellet feed is widely used because it is readily available, and the price varies, ranging from cheap to expensive. There are also artificial feeds made in the form of cakes made on IBAT Puntren for farmed fish. [10]. In Sumedang cultivation, the feed given is in the way of artificial feed, which is pellet.

2.2 IoT (Internet of Things)

The concept of system design in the implementation of the construction of automatic fish feed equipment is based on the Internet of Things (a case study of fish farming in Sumedang). This IoT is used to facilitate farmers in cultivating their fish. The design of this automatic fish feed system also requires hardware for supporting media from the

IoT. Among them, there are Arduino boards, ultrasonic sensors, pH sensors, etc.

IoT is all activities where the actors interact and are carried out using the internet. In its use the internet of things is often found in various activities, for example: the number of online transportation, e-commerce, booking tickets online, live streaming, e-learning, etc. even to the tools to help in specific fields such as remote temperature sensors, GPS tracking, and so on who use the internet or network as a medium to do it. [8].



Picture 1. Internet of Things. [8]

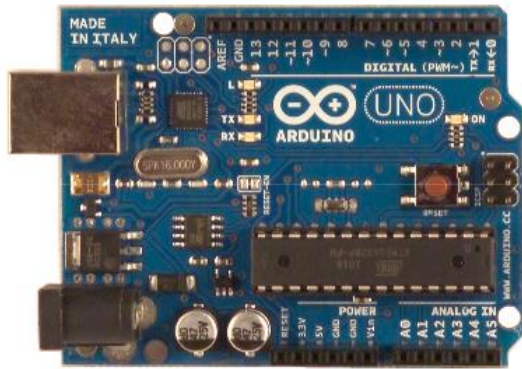
2.3 Mikrokontroler

2.3.1 Board Arduino

Arduino is a microcontroller board that is open source, not just a development tool, but it is a combination of hardware, programming language, and Integrated Development Environment (IDE).

Arduino IDE is critical to write programs, EMG-compile it into binary code and upload it to the microcontroller memory. The Bootloader Chip / IC on the Arduino Board has been filled with the Arduino Bootloader program, which allows us to upload the program code without using additional hardware.

The bootloader will be active for a few seconds when the board is reset, the compilation of the Arduino IDE can be used and run not only on the Arduino board but can also be run on the appropriate AVR microcontroller system even without the bootloader. Bootloaders are small initiation programs, run by the CPU when the power is turned on. After the bootloader has finished running, the next program in RAM will be executed. [5].

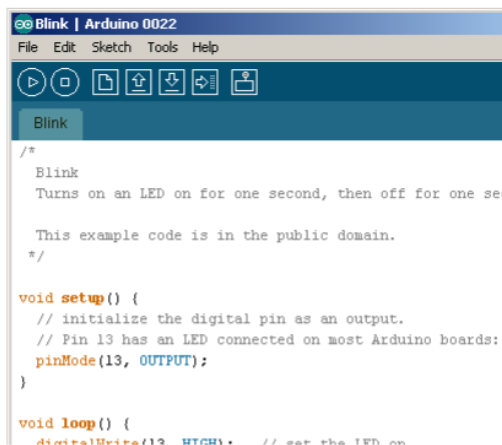


Picture 2. Board Arduino. [5]

2.3.2 Software IDE Arduino

Arduino IDE is a very sophisticated software written using Java. The Arduino IDE consists of:

1. Program editor, a window that allows users to write and edit programs in the Processing language.
2. Compiler, a module that converts program code (Processing language) into a binary system. However, a microcontroller will not be able to understand the Processing language. What can be followed by microcontrollers is binary code. That is why a compiler is needed in this case.
3. Uploader, a module that contains a binary system from a computer into memory on the Arduino board..



Picture 3. Antarmuka Software IDE Arduino. [5]

1.3.3 Arduino Programming Language

Syahwil (2013: 80) states that many languages can be used for microcontroller programs, such as assembly languages. But in Arduino programming, the language used is C language.

Kusuma (38) states that the root of the C language is the BCPL language developed by Martin Richards in 1967. The C language is the standard language, meaning that a program written in the C language version will undoubtedly be compiled with another C language version with a few modifications. Some

reasons why C language is widely used, including the following [4]:

1. C language is available in almost all types of computers
2. The C language code is portable
3. Language C only provides a few keywords.
4. C language program executable process is faster
5. Great library support.
6. C is a structured language
7. In addition to high-level languages, C is also considered to be an intermediate level language
8. The C language is a compiler.

3. ANALYSIS AND DESIGN

1.1 Communication

Communication is the decomposition stage obtained from research to be able to identify and evaluate problems that occur.

1.1.1 Problem Analysis

The problems found in research into the construction of automatic fish feed equipment are as follows:

1. Cultivators sometimes skip the feeding of fish, which results in harvest time, so that the cultivator loses.
2. Provision of fish feed using estimation techniques among farmers that cause fish not to grow properly as seen from some of the physical growth of the fish, causing economic losses.

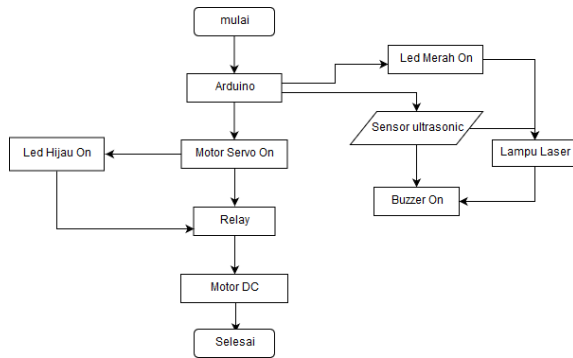
1.1.2 System Analysis that's running

Analysis of the system that is running is a stage that aims to explain the policy that is currently running.

1. Cultivators provide feed manually (feed is sown directly by farmers)
2. Cultivators provide feed two to three times a day
3. The amount of feed given at each time is 5% of the weight of fish
4. Cultivators clean the pond only during the harvest period.

1.1.2.1 Analysis System to be built

Analysis of the system to be built is the result of design to replace the ongoing procedures for fish farming in Sumedang using the IoT system. The new business process can be seen in Figure 4 below.



Picture 4. Analysis Sistem to be built

1. 1. When the ultrasonic sensor detects the movement of fish, then through the Arduino microcontroller, the servo motor will run automatically to provide feed, and when the servo motor is on, the light will turn green.
2. 2. When the ultrasonic sensor does not detect, and the servo motor is not running, then the light is red.

1.1.3 Analysis of Non-Functional Needs

Non-functional requirements analysis is a system that is carried out to determine the specifications of the system requirements to be built. Analysis of non-functional requirements on this system includes user analysis, hardware analysis, and software analysis..

Tabel 1. Hardware Requirements Analysis

No	Hardware	Spesification
1	Mikrokontroller	Arduino Uno
2	Power Supply	Micro USB
3	Sensor Ultrasonic	HC-SR04
4	Sensor PH	PH-4502C
5	Driver Motor Stepper	2A 333 oz.in Torque
6	Modul Bluetooth	Bluetooth HC

1.1.4 Analysis of user requirement

User analysis is a condition of users who can run this automatic fish feed system, while the provisions of the system users are as follows:

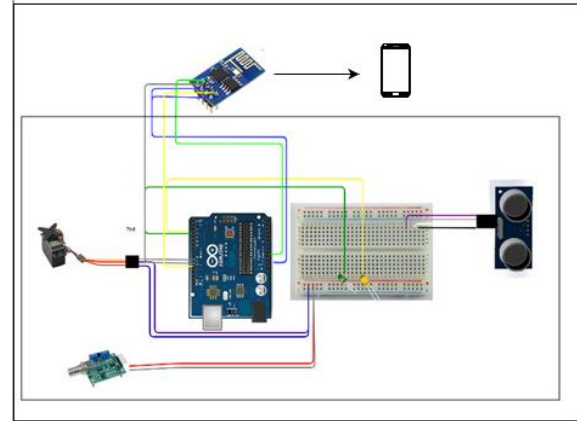
1. Users can operate Android devices.
2. Android devices used by users must be connected to the internet.
3. The user must have an Automatic Fish Feed System application to be able to monitor the condition of the goldfish.

With the characteristics of the users above, it can be concluded that the user is able to use applications that are made, at least able to understand or can run Android devices.

1.2 Quick Plan

At this stage, the prototype was designed. The prototype that is made is adjusted to the system that has been predefined from the problems faced by farmers.

1.2.1 System Architecture Analysis



Picture 5. System Architecture Analysis

The following is an explanation of the architecture of an automatic fish feeder using Arduino:

1. Arduino UNO/ functions as the central controller or the core of the system to read, manage, process, and display data from all devices and connected components.
2. Power Supply: used for microcontroller power supply, can also use micro USB.
3. PH sensor is a sensor to measure the acidity or base of a liquid. In this study, the ph sensor is used to control the condition of the water in the pond, so it does not affect the growth of fish in the lake.
4. Stepper Motor is one type of dc motor that is controlled by digital pulses. The working principle of a stepper motor is to work by converting electronic pulses into discrete mechanical movements where the stepper motor moves based on the sequence of pulses given to the stepper motor.
5. HC-05 is a Bluetooth SPP (Serial Port Protocol) module that is easy to use for serial wireless (wireless) which converts serial ports to Bluetooth. HC-05 has two configuration modes, namely AT mode and communication mode. AT mode functions to perform configuration settings of HC-05. And communication mode to do Bluetooth communication with other terminals.
6. Android smartphone, used as an interface between the user and the system for monitoring.

1.3 Quick Plan

At this stage the system prototype modeling is adjusted to the system design.

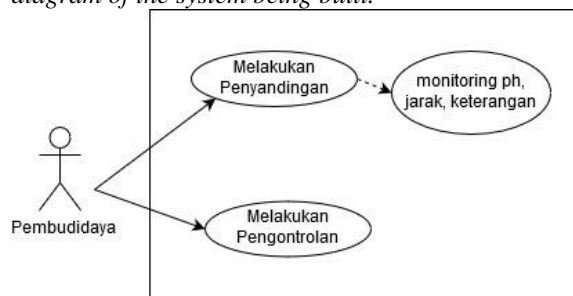
1.3.1 Analysis of Functional Needs

Functional requirements analysis is the process of what activities will be applied to the system and

explain the needs needed so that the system can run well and in accordance with the needs of the system. The analysis conducted is modeled using UML (Unified Modeling Language). The modeling stages in the analysis include making use case diagrams, use case scenarios, activity diagrams, sequence diagrams, and class diagrams.

1.3.1.1 Use Case Diagram

Use case diagram is a technique used in the development of a software to capture the functional needs of a system in question, the use case also explains how interactions occur between actors, initiators of the system's own interaction with existing systems. Figure 3.4 below is a use case diagram of the system being built.



Gambar 6. Use Case Diagram

4. IMPLEMENTATION AND TESTING

1.1 Construction of Prototype

This stage contains hardware implementation specifications, software specifications, testing blackboxes for the Automatic Fish Feeding System in Carp Farming in Eloy Fish Sumedang District Based on Internet of Things (IoT) Fish Based Behavior Patterns (IoT) and Android Applications.

1.1.1 Implementation of hardware

In the hardware implementation section, it will be explained what hardware is implemented for system development needs.

- controller hardware

The controller hardware is a device consisting of a microcontroller and a sensor. Controller specifications can be seen in the following table

Tabel 2. IoT hardware and system implementation

No	Hardware	Specification
1	Mikrokontroller	Arduino Uno
2	Power Supply	Micro USB
3	Sensor Ultrasonic	HC-SR04
4	Sensor PH	PH-4502C
5	Driver Motor Stepper	2A 333 oz.in Torque
6	Modul Bluetooth	Bluetooth HC

- Smartphone hardware

This section discusses the hardware used to run the monitoring system. Details of the hardware used can be seen in the following table..

Tabel 3. Smartphone hardware for system implementation

No	Hardware	Specification
1	Chipset	Qualcomm SDM363
2	CPU	Octa-core 1,8 GHz
3	Ram	2 GB
4	Storage	32 GB
5	Jaringan	GSM/HSPA/LTE

1.1.2 Software Implementation

Software specifications used in the design and implementation of the internet of things (iot) for automatic fish feed equipment, can be seen in the table below

- Software on the Controller

In order to run a water quality monitoring system. The controller used is software that is needed. In the following tabel can be seen the implementation of software on the controller.

Tabel 4. Software implementation in the controller

No	Perangkat Lunak	Spesifikasi
1	Sistem Operasi Desktop	Windows 10
2	Bahasa Pemrograman	C
3	Code Editor	Arduino IDE

- Software on Smartphones

In order to run a water quality monitoring system. The smartphone that is used already has the required software installed. In the following tabel can be seen the implementation of software on the Smartphone.

Tabel 5. Software implementation on smartphone

No	Perangkat Lunak	Spesifikasi
1	Sistem Operasi	Android 5.0
2	Internet	Terkoneksi dengan jaringan internet

1.1.3 Testing the Whole System

System testing is the most important thing that aims to find errors or deficiencies in the information system being tested. System testing is intended to determine the performance of information systems that have been made in accordance with the objectives of information system design. Types of Testing conducted include testing Functionality and Usability.

The test plan that will be carried out is by testing the system that has been built on the Functionality side of the system maker by Black Box and from the Usability side by the user through interviews.

1.1.2.1 Understanding the System

System testing is the most important thing that aims to find errors and deficiencies in the software. Testing the system used to find out the software that is made already meets the criteria in accordance with the purpose of software design. This software testing uses black box testing and user acceptance testing using cuiosioner. [11]

1.1.2.1 Black Box Testing

Black box testing focuses on whether the software built meets the requirements mentioned in the specifications. Tests carried out by running or executing units, then observed whether the results of the units tested whether in accordance with the business process or not

a. Testing Scenarios

Software testing scenarios for users on ph and feed monitoring systems can be seen in the following table.

Tabel 6. Skenario Pengujian

Kasus Uji	Detail Pengujian	Jenis Pengujian
Monitoring PH	Melihat monitoring ph air	Black Box
Perhitungan PH	Melihat riwayat perhitungan ph air	Black box

a. Cases and test results

Testing is done by testing each process for possible errors that occur.

1. Testing the receiver

Following is the receiver table to see the data of water ph monitoring results. Can be seen in Table 7.

Tabel 7. Hasil Pengujian Receiver

Kasus dan Hasil Uji (Data Benar)			
Aksi/D ata Masuk an	Yang diharapka n	Pengamat an	Kesimpu lan
Mengkl ik button terminal	Menampil kan monitorin g ph air berupa	Berhasil menampil kan monitorin g nilai ph,	[√] Diterima [] Ditolak

nilai ph, jarak sensor dan keterangan n ph	jarak sensor dan keterangan n ph	
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1. Terminal testing

Following the terminal table to see the ph calculation history. Can be seen in Table 8.

Tabel 8. Hasil Pengujian Terminal

Kasus dan Hasil Uji (Data Benar)			
Aksi/Dat a Masuka n	Yang diharapkan	Pengamata n	Kesimpula n
Mengkli k button terminal	Menampilka n riwayat perhitungan ph, jarak sensor dan keterangan ph	Berhasil menampilka n riwayat perhitungan ph, jarak sensor dan keterangan ph	[√] Diterima

1.1.2.1 Conclusion Black Box Testing

Based on the results of the Black Box tests that have been carried out, it can be concluded that functionally the entire process in the Water Quality Monitoring System in goldfish farming has been running as expected.

1.1.2.2 Hardware testing

a. PH sensor testing

The testing of the SEN0161 water ph sensor is done by comparing the value received from the sensor with a ph meter. The measurement results can be seen in Table 9.

Tabel 9. Hasil Pengujian Terminal

Percobaan	Pengukuran Sensor (p1)(ph)	Data
1	7,68	
2	7,67	
3	7,62	
4	7,51	
5	7,46	
6	7,66	
7	7,99	
8	7,99	
9	7,86	
10	7,86	

The results of measurement of water quality parameters show that the value of water quality parameters during the study is still in the range that is suitable for goldfish cultivation (C.Carpio), a

range of 7.4 - 7.6 with feasibility (literature) 6.5 - 9.0.

b. Ultrasonic sensor testing

Testing of the HC-SR04 ultrasonic sensor is done by comparing the value received from the sensor with a conventional water level meter. The measurement results can be seen in Table 10.

Tabel 10. Hasil Pengujian Terminal

Percobaan	Pengukuran Data Sensor (p1)(cm)	Pengukuran Alat Konvensional (p2)(cm)	Selisih Pengukuran Abs(p2-p1)/p2 x 100%
1	115	116	0,00602%
2	118	119	0,00591 %
3	115	116	0,00602%
4	118	120	0,01176%
5	118	120	0,01176%
6	124	125	0,00571%
7	126	128	0,00561%
8	108	110	0,0125%
9	109	110	0,00625%
10	119	121	0,01169%
Rata-rata persentase kesalahan			0,00832%

With the test results above, it can be concluded that the ultrasonic sensor can be used in the system to be made and can function properly.

a. Testing the Bluetooth HC module

This test is conducted to find out whether the microcontroller with Bluetooth is connected properly or not. Testing is done by sending karkater from the smartphone to the microcontroller via Bluetooth, if Bluetooth receives the character and resends it to the smartphone it means the connection between the microcontroller, Bluetooth and smartphone is well connected..

2. CONCLUSION

2.1 Conclusion

Based on the results obtained from the research conducted in the preparation of this thesis and referring to the research objectives, it can be concluded:

1. With the design and application of the internet of things (iot) to monitor this ph, it can facilitate farmers in monitoring ph in the process of cleaning fish ponds so that it can produce good water quality for fish growth.
2. With the design and application of the internet of things (iot) to control this automatic fish feeder, farmers can easily provide feed without having to go to the pond.

2.2 Suggestions

1. This system and application still need further development. Not only can you monitor and see the ph history of

calculations, as for suggestions that might be applied to the design and application of the internet of things (iot) to control these other tools so that they can be even better, are as follows:

2. 1. Can develop existing models and automatic feeding systems so that they become even better.
3. 2. Development can be done by improving the design of the tool in terms of appearance to make it more attractive
4. 3. In this tool for water pH can only monitor or measure only and there is no automatic control, because there is no electronic-based tool or microcontroller that can be used to control water pH. So that in the future it can be developed again.

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