Journal of Electronics, Electromedical, and Medical Informatics (JEEEMI)
Vol. 2, No. 3, October 2020, pp. 119-124
DOI: 10. 35882/jeeemi.v2i3.6 **ISSN:2656-8632**

Design of Pond Water Turbidity Monitoring System in Arduino-based Catfish Cultivation to Support Sustainable Development Goals 2030 No.9 Industry, Innovation, and Infrastructure

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Article Info

Article History:
Received Sept 15, 2020
Revised Sept 30, 2020
Accepted Oct 21, 2020

Keywords:
Arduino Uno
LM35
LDR
Flow mete
Cat Fish

Abstract

Catfish is one of the fishery products favored by the community because of its high protein. So that catfish is one of the fish that is the center of business for fish farmers. The pond conditions used by catfish farmers are generally still conventional. So that the maintenance of clean water in ponds is still done manually and even escapes attention. Water conditions will affect the health and productivity of catfish. In order to achieve the optimum conditions in the third media, a control system consisting of three types of sensors will be used, namely Flowmeter, LDR sensor and LM35 sensor. The flowmeter sensor is used to regulate the flow of water, the LDR sensor functions as a receiver that is used to detect the level of turbidity of water based on how much light enters the water (turbidity). Meanwhile, the LM35 sensor functions to detect the temperature in the media so that the optimum condition for catfish based on temperature parameters is around 22 - 32 ° C.

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I. Introduction

Every living thing needs food. Without food, living things will not be able to carry out their daily activities because living things do not have energy. Energy is the main thing that humans need to be able to keep moving and doing activities and carry out their daily obligations. Intake of nutritious food that is strong and balanced is able to maintain good endurance. one that the body needs is protein. The benefits of protein for the body are related to almost all activities that a person does every day. Moreover, protein is one of the most abundant substances in every cell in the human body. The main benefits of protein for the body are as a source of energy, just like carbohydrates and fats. In terms of excess intake, protein can be said to be similar to carbohydrates. If the body consumes more protein than is needed for tissue maintenance and other important functions, the excess protein will be converted into fat and will become a source of reserve energy for the body. In addition, one way the body regulates pH is by using protein. protein acts as a buffer system by helping the body maintain proper pH values of blood and other body fluids. The benefit of protein for the body is to regulate the body to always maintain fluid balance.

The benefits of protein for the body can be obtained from various types of food. Sources of protein found in food include meat, fish, dairy products, eggs, peas or lentils. one of the fish that has a high protein content is catfish. The function of the protein content in catfish is not only to increase the intake of protein consumed, but also to complement good protein in food. In the protein in catfish, there are essential amino acids lysine, methionine, and leucine, even the protein contained in catfish is higher than the protein in milk and beef.

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Currently, the need for food with high benefits is increasingly being sought by the community. Catfish is one of the foods that people like because of its high protein [3] - [3]. This commodity makes catfish have very promising prospects, both in terms of demand and selling price [4] - [5]. It can be said that from a market point of view, catfish has the potential to be developed as business land [6]. However, in its development, farmers face the problem of low productivity. One of the problems is seen from the cloudy condition of the pond water so that catfish is covered with disease. [7]. Although basically this condition does not directly affect the mortality rate for catfish, the fish would be better off if they could live in their optimum area [8]. In previous research conducted by Suryadi (2013), a study entitled Control System and Monitoring of Water Turbidity Levels in Filtration Tubs as RAW MATERIALS for Clean Water, this research focuses on PDAM Makassar City water located on Jalan Ratulangi. In this study, the variables regarding water temperature were not observed. besides that, the output of the system is an LCD display without any action on the measured water level measurement.

The problem that arises in the community is the driving force for the author to conduct research on catfish ponds. This research was conducted by observing the conditions of catfish (mortality, weight, harvest time) which were placed in three types of pond media including, pond media in general, pond media with stimulants, pond media with stimulant systems and drainage control [9]. This new system is expected to accelerate growth and reduce catfish mortality in ponds, thereby increasing the welfare of tilapia farmers and the fulfillment of protein housing for the community [10].

II. Materials and methods

The method of designing tools is by providing research support tools and materials in the form of hardware (LDR, LM35, LCD, Arduino uno, Natural Filtration Materials and HC-SR 04) and software (Eagle PCB and Arduino IDE). This research consisted of several stages, namely the design of the hardware, the connection between the hardware, the creation of the software, the synchronization between the hardware and the software, and the stages of testing and analysis of the results. The following is the design of the water purifier hardware design.

The literature study carried out includes the study of basic theories regarding the design of hardware and software systems which include water clarity sensors, flowmeter sensors, water pump drivers, water pumps, Arduino Uno and LCD Keypad. The method of designing tools is by providing research support tools and materials in the form of hardware (LED, LDR, 125W Water Pump) and software (Eagle PCB and Arduino IDE). This research consisted of several stages, namely the design of the hardware, the connection between the hardware, the creation of the software, the synchronization between the hardware and the software, and the stages of testing and analysis of the results. The following is the design of the water purifier hardware design.

A. Materials and Equipments

The tools and materials used as support in this study are as follows:

1) Hardware

1. Sensor pH
2. LDR
3. Elektro Tester
4. LCD
5. Arduino Uno
6. Natural Filtration Material
7. HC-SR 04
8. Filtrasi UV

2) Software

1. Eagle Pcb
2. Arduino Ide

B. Systematics of Control Systems

1) Turbidity sensor

Diode laser as transmitter and LDR as receiver, are used to detect water turbidity levels. The level of water turbidity is used as an indicator by Arduino Uno R3 to activate or deactivate the relay and to turn on or off the selenoid valve to fill the filtration water to the aquarium. The turbidity sensor will be installed based on the turbidity principle. This turbidity will represent some of the optimum parameters for catfish, namely the level of water clarity. When the sensor still has the ability to receive light, it can be said that the water is still suitable as a habitat for catfish. The design of the clarity sensor used 4 diode lasers and 4 LDRs to take the average value as a reference in programming. This is done so that when one of the sensors is blocked by an object or particle which will cause the ADC value to be large, the other sensor will detect it first.

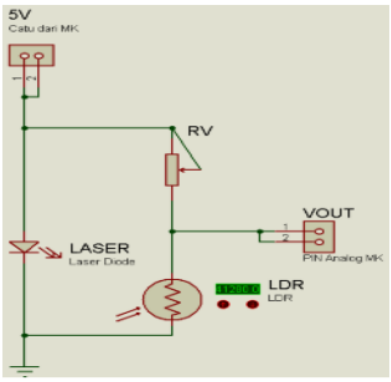

Fig. 1. Turbidity sensor circuit

2) Relay Driver Design.

The output from the microcontroller is forwarded to a relay that activates the 220 VAC power supply to be used as supply to the solenoid valve.

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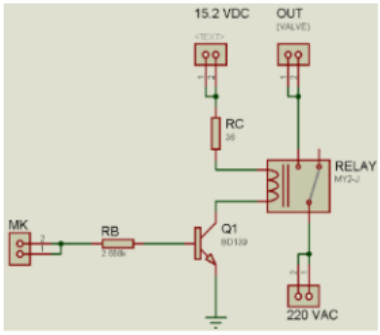

Fig. 2. Relay Driver Circuit

3) Flowcharts and block diagrams

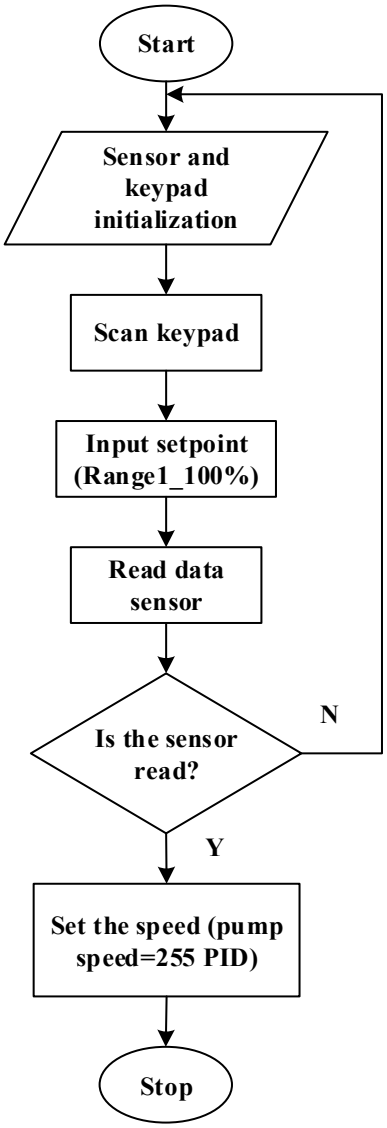

Fig. 3. Flowchart

The flow of the testing process for the initial system start tool, namely first the sensor initialization (clarity sensor 1, clarity sensor 2, flowmeter sensor) and keypad, then scanning the keypad, then entering the setpoint value for the input setpoint range from 0 to 100%, if the sensor value is read then the system will start the filtration process, then the values of Kp, Ki, Kd will be adjusted according to the error value and the change in the clarity of the filtered water output. Then the PID output value will be converted into PWM form and mapped in the range 0 - 255. Can be seen in Figure 2.

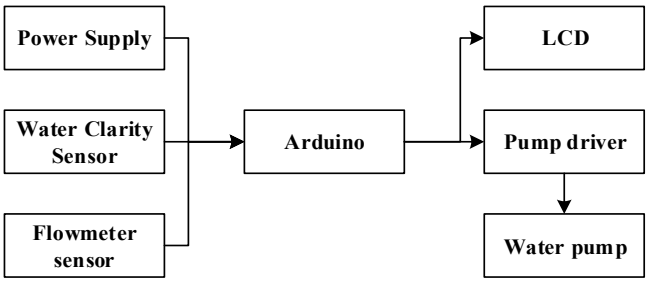

Fig. 4. System Block Diagram

The system block diagram contains an input and output system. Seen in Figure 3. The input system is a clarity sensor and flowmeter sensor and the output system is an LCD and an AC motor driver for the water pump. There are 2 clarity sensors, namely the clarity sensor on the input water and the clarity sensor on the output water.

In this study, calibration was also carried out on the LDR sensor and Flowmeter sensor to get results that match the tools that have become the benchmark for calibration. Calibration is carried out on all sensors used.

III. Results

The discussion of the results of the water purification device stimulation test consists of several discussions of the test results including sensor testing, Arduino Uno R3 testing, relay testing, power supply testing, sensors and testing the work system as a whole.

A. Hardware Testing (Hardware)

1) Testing the Water Clarity Sensor Circuit

TABLE 1 WATER FILTRATION TEST RESULTS

No	Water medium	Sensor reading
1	Water without Ink	94 %
2	Water without Ink 2.5 ml	92 %
3	Water without Ink 5 ml	90 %

Based on the results of the test, the clarity sensor is made in the range 0 - 100%. The value of 0% is the smallest level of water clarity and the value of 100% is the highest level of water clarity. In table 1. It is known that the sensor reading value is linear with the increase in the amount of dissolved ink.

2) Flowmeter Sensor Testing

In table 2. It is known that the reading of the flowmeter sensor is linear to changes in water flow passing through the sensor. In table 4.3 when the valve is in position 0o (fully open) the flow rate is 676 L / H, when the valve is at 24.5o the water flow rate is 541 L / H, then at the valve position 45o the flow rate is 405 L / H, and at valve position 67.5o the flow rate is 262 L / H, then at the valve position 90º (closed) the flow rate is 0 L / H.

TABLE 2 FLOWMETER SENSOR TEST RESULTS

No.	Valve angle position (degrees)	Sensor reading value
1	0	676
2	24.5	541
3	45	405

From the tests that have been done, a graph can be made like the one below.

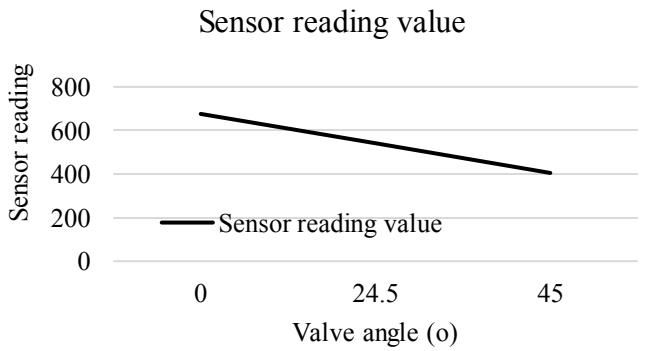

Fig. 5. Flowmeter Sensor Testing Graph

In testing this sensor reading, data is obtained which explains that the greater the angle of the valve, the smaller the sensor reading will be, and vice versa.

3) Pengujian PWM Digital Dimmer

TABEL 3 PENGUJIAN DRIVER PWM DIGITAL *DIMMER*

No	Arduino PWM value	Driver output voltage
1	0 Bit	0 volt
2	30 Bit	50 volt
3	67 Bit	75 volt

The PWM Digital Dimmer driver circuit is used to drive a water pump motor with a 220 volt AC supply voltage. The circuit functions to regulate the output voltage of the circuit. Testing the PWM Digital Dimmer Driver circuit is done by measuring the output voltage from the circuit using the avometer. The following is a table of the results of measuring the output voltage in the PWM Digital Dimmer Driver circuit.

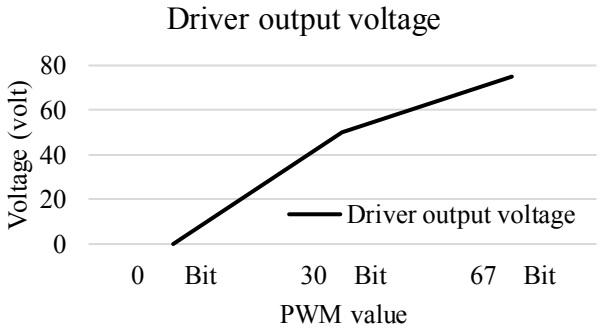

Fig. 6. PWM Dimmer test chart

In figure 6, it is known that the pump driver voltage output is influenced by the PWM output of Arduino. The greater the PWM value, the greater the voltage generated by the pump driver.

4) Testing System Capability to Perform Filtration

In testing the ability of the system to perform filtration, namely by recording the results of the clarity of the water produced by the system with a certain level of clarity setpoint value. In this tool system, the water to be filtered has its clarity limited to a 60% clarity value, when the clarity of the input water or Tin <60, the system will stop the filtration process. Because in the test results for water clarity below 60% the filter media is no longer able to perform filtration, causing the filtration water to be not optimal.

In table 4, it is known that the Tout value> setpoint, in this condition the filtered water has met the clarity of the filtration water above the setpoint so that the pump motor returns to normal speed with a PWM output of 254 and an average water flow speed of 872 L / H.

TABLE 4: TESTING THE SYSTEM IN FISH POND WATER WITH A WATER CLARITY VALUE LEVEL OF 62%. AND THE SETPOINT IS 91%

No	*Setpoint* (%)	Input clarity	Output clarity	Motor control (PWM output)	Water flow rate (L / H)
1	91 %	62 %	97 %	254 Bit	872
2	91 %	62 %	96 %	254 Bit	872
3	91 %	62 %	95 %	254 Bit	872

In table 5, it is known that the Tout value at the beginning of the filtration is greater than the set point because at the beginning of the filtration the clarity sensor has not detected the output clarity (Tout) so that the motor speed is still in normal conditions, namely at maximum speed. After the Tout clarity sensor detects a change in clarity, from a value of 94% to 83%,

the pump motor speed slows down according to the PID output control signal, namely the equation (motor control = 255 - Out_PID). Then after the motor speed slows down, the output clarity (Tout) again increases until the clarity level of 94%. In this condition, the filtered water has met the clarity of the filtration water according to the setpoint so that the pump motor returns to normal speed with a PWM output of 254 and an average water flow rate of 872 L / H.

TABLE 5 TESTING OF THE SYSTEM IN FISH POND WATER WITH A WATER CLARITY VALUE OF 62% AND A SETPOINT OF 94%

No	*Setpoint* (%)	Input clarity	Output clarity	Motor control (PWM output)	Water flow rate (L / H)
1	94 %	62 %	96 %	254 Bit	872
2	94 %	62 %	95 %	254 Bit	872
3	94 %	62 %	94 %	254 Bit	872

From the results of the tests that have been carried out, it is known that the system is difficult to achieve the clarity of the filtered water at the set point at the beginning of the process. This is influenced by the main factor, namely the design of the filtration tube between the filtration discharge and the unbalanced size of the filtration tube, the small filtration tube is unable to accommodate more filter media, so the filtration process is not optimal in filtering water with a large water flow. From some test data, it can be seen that the results of the research are in accordance with the theory that changes in the speed of water flow entering the filtration media can affect the results of the resulting water clarity. The slower the water flow that enters the filtration media, the maximum water yield from the filtration process and vice versa, the faster the water flow rate that enters the filtration media, the less maximum the water yield from the filtration process. In addition, another factor that affects the clarity of the filtration is the filtration media used. In the filtration process with a high water flow rate, the filtration media should be used with very small pores such as gauze.

IV. Discussion

Water quality is an important factor influencing fish health in the aquaculture production system. Good water quality refers to what the fish want. This means that we must understand the requirements for the quality of fish water that is properly cultivated. Fish are alive and highly dependent on the water they live in for all their needs. Different fish species have different and specific aspects of water quality (temperature, pH, oxygen concentration, salinity, hardness, etc.) in which they can survive, grow and reproduce. Within this tolerance limit, each species has its own optimum range, that is, the range in which it performs best. Therefore, it is very important for fish producers to ensure that the physical and chemical conditions of the water remain as much as possible within the optimal range of farmed fish at all times.

Outside this optimal range, fish will show poor growth, erratic behavior, and symptoms of disease or parasite infestation. In extreme cases, or where bad conditions persist for a long period of time, fish mortality can occur. Pool water contains two main groups of substances:

- Suspended particles are made up of inanimate particles and very small plants and animals, plankton.
- Dissolves made of gases, minerals, and organic compounds.

The composition of pond water changes continuously, depending on changing climate and seasons, and how the pond is used. Good management aims to control the composition to produce the best conditions for fish. In order for producers to maintain ideal pond water quality conditions, producers must understand the physical and chemical components that contribute to good or bad water quality.

V. Conclusion

Based on the results of the analysis and discussion that has been carried out, several conclusions can be drawn, namely the value of linear clarity sensor readings to changes in solutes in water, namely the clarity value decreases by 2% for the addition of solute 2.5 ml ink in water and the flow rate of water flow entering the media filtration can affect the clarity of the filtration process. From this research, you can add data communication using a network, and you can also add a data storage to find out the track record of this system.

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