Design and Build Automatic Catfish Feeding System Biofloc

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***Abstract*—Catfish is one of the results of freshwater cultivation that is popular with the community and has economic value. The high public interest in catfish, is one of the factors cultivators increase production yields. Feeding and treatment of catfish pond water still uses human resources. This reduces the efficiency of the farmer and allows for negligence in providing feed and water treatment if the farmer has a large number of ponds or more than one. In this study, it is proposed to control and monitor feeding and water treatment with a biofloc system automatically and regularly, with the catfish biofloc system also obtaining natural food when the feeding schedule is raining. It takes a wireless sensor network system as a control system, fc-37 sensor, Total Dissolved Solids (TDS), Loadcell, Real Time Clock (RTC). All of these sensors will be integrated with the Arduino Uno which will then send data from each sensor to the Raspberry Pi with the nRF24l01 communication module. The results of this study are monitoring the appearance of the web server processed by the Raspberry Pi which shows feed availability, pond conditions and turbidity levels. From the experimental results, it is found that the planned system can work well and as desired.**

***Keywords*— Biofloc, Catfish, Control, Loadcell, Monitor, TDS.**

I. INTRODUCTION

Catfish is one of the most popular freshwater aquaculture products. The high public interest in catfish, is one of the factors cultivators increase production yields. Feeding is a factor that must be considered by farmers. In the process of feeding, the weather must be considered in order to avoid stress levels that can cause the death of catfish [1]. Especially during rainy conditions, fish should not be fed directly using pellets, with a management system using biofloc [2] , fish can obtain feed from flocs produced from the process of leftover feed and fish manure fermented with molasses and probiotics so that they can produce flocs. as a natural fish food when it rains.

Feeding and treating catfish pond water still uses human resources. In previous studies, the automatic catfish feeding system was only implemented in one pond [3][4]. This reduces the efficiency of the farmer in providing feed [5] and water treatment [6] if the farmer has a large number of ponds or more than one. In addition, this can allow for negligence of cultivators in meeting the needs of catfish evenly.

Based on these problems, we need a feed system and fish pond water treatment with an automatic biofloc cultivation system to increase the efficiency of farmers. This system is based on a wireless sensor network [7][8] where there are sensor nodes [9] and server nodes [10]. In this system, sensor nodes are placed in each catfish pond. Each sensor node has a servo motor [11] and DC motor [12] to drive the feed reservoir and liquid tube, a TDS meter [13] to determine the level of water turbidity [14], an FC-37 sensor to detect rainwater, an NRF24l01 communication module [15] for communication between the sensor node and the server node, and an RTC sensor for set a feeding schedule. These sensors are integrated into the Arduino Uno microcontroller. Then the data is transmitted from the sensor node to the server node using the NRF24l01 communication module. The data is processed on the Raspberry Pi microcontroller located on the server node. Then the data will be displayed on the website display for feed availability, water turbidity level, and feeding schedule.

II. METHOD

A. *System Block Diagram*

The block diagram of this research is shown in Figure 1. Based on Figure 1 there are 3 nodes, with 2 as sensor nodes and 1 as server nodes. at each sensor node there are TDS, RTC, Loadcell sensors and the nRF24L01 communication module. Then on the server node there is a Raspberry Pi and the nRF24L01 communication module.

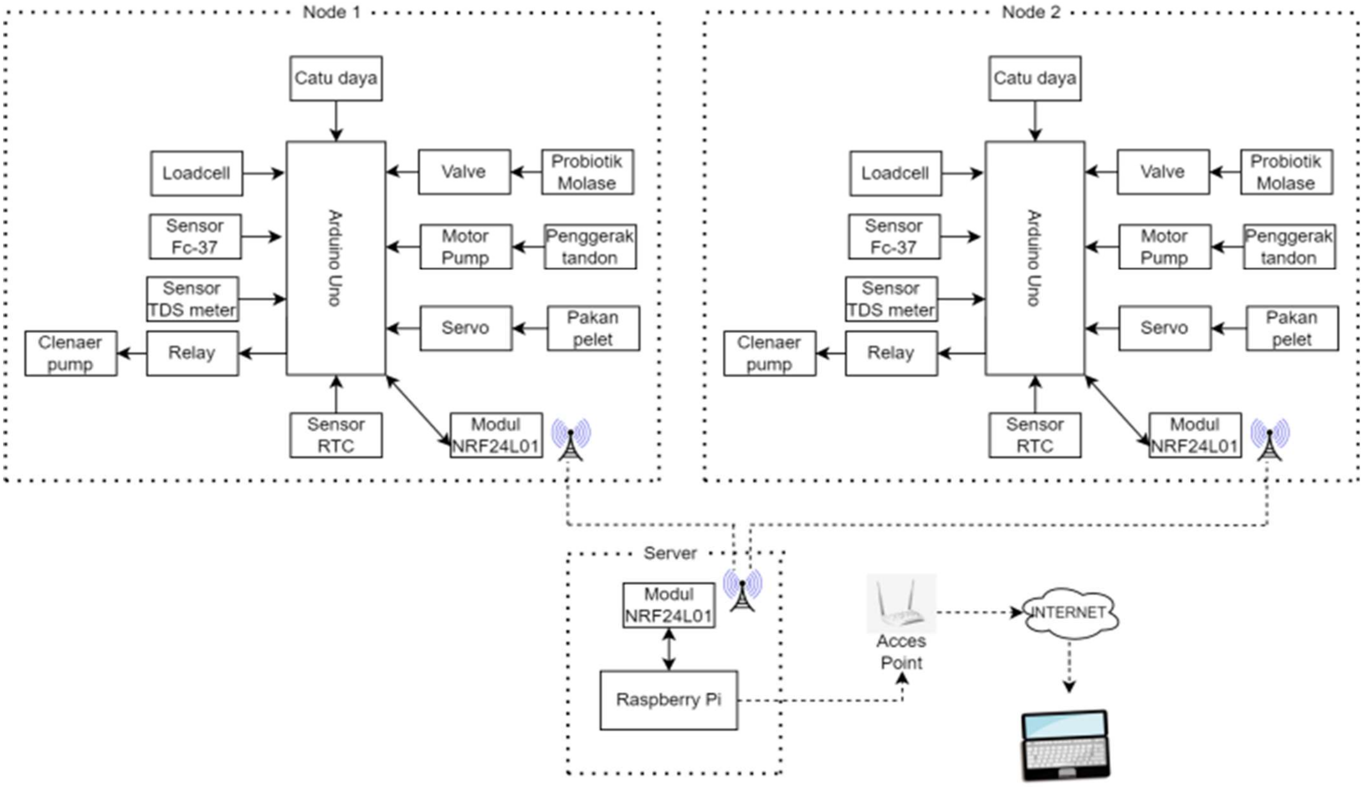

Figure 1. System blok diagram

B. *Mechanincal Design*

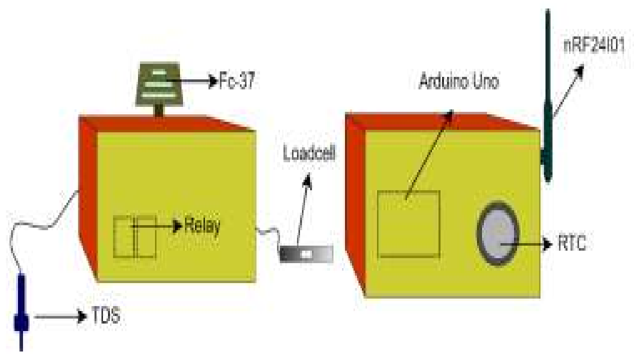

Figure 2. Overall mechanical design

Fig. 2 shows the mechanical design of sensor nodes. There are TDS sensors, Fc-37 sensors, loadcell sensors, and RTC sensors, all of these sensors will be connected to Arduino Uno, then there is a communication module, namely nRF24l01.

C. *Hardware Planning*

In the hardware design in Figure 3 shows a circuit to monitor each pool point, several components are needed, namely the TDS sensor, Loadcell, RTC, Fc-37, and the nRF24L01 module which is integrated with Arduino Uno which works to transmit data to the server.

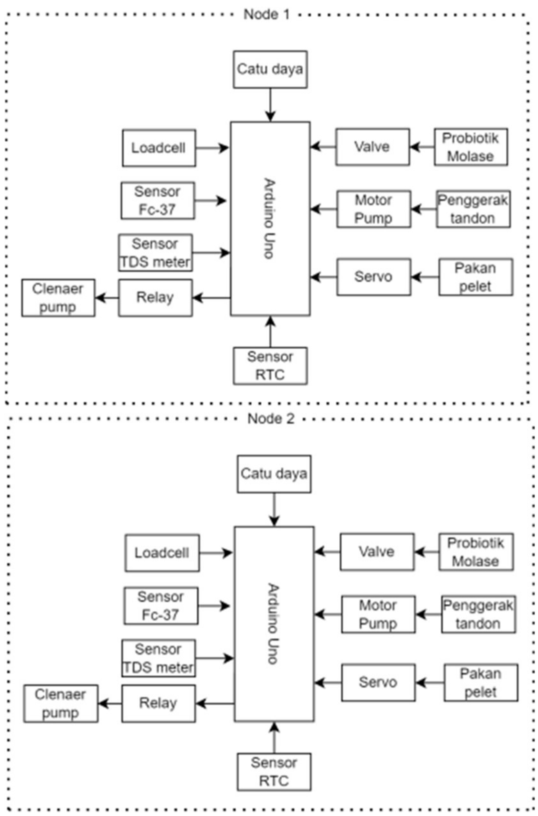

Figure 3. Diagram hardware in node sensor

Fig. 4 shows the circuit scheme on the server node which consists of Raspberry pi and nFR24l01 components as communication modules, the working system, namely the server, will receive information data on each sensor node through the nRF24l01 communication module. then after the data is processed it will be displayed on the web server.

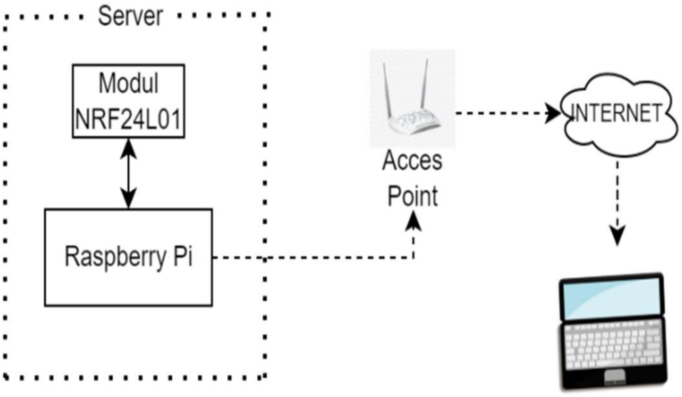

Figure 4. Diagram hardware in node server

Sensor data received by the server will be stored by Raspberry Pi. Then the data will be processed in a database and represented on a web server to provide information on feed availability, weather conditions, turbidity level, and feeding schedule, as shown in Fig. 4.

D. *Website Planning*

Fig. 5 Website planning

Fig. 4 shows the web server display design to determine the condition of the pool and its environment. The following main page displays feed availability, weather conditions, turbidity levels, and feed schedules which will be displayed in real time and in the form of graphs. It also displays a logs tab that displays the overall value of sensor node 1 and sensor node 2.

III. RESULTS AND DISCUSSION

A. Hardware Circuit Results

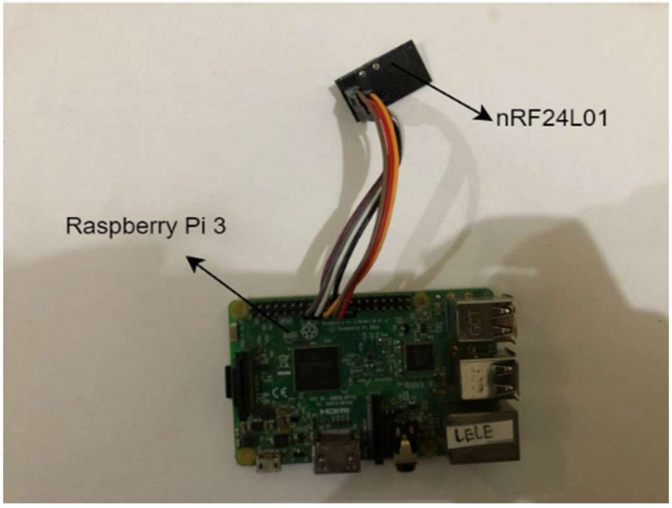

Fig. 6 Circuit on Node Server

Fig. 6 shows a circuit on a server node that functions as a local server. In the circuit there is a Raspberry Pi that works as a server, then there is a communication module nRF24l01 as a data transmission receiver from each sensor node.

B. Circuit on Node Sensor

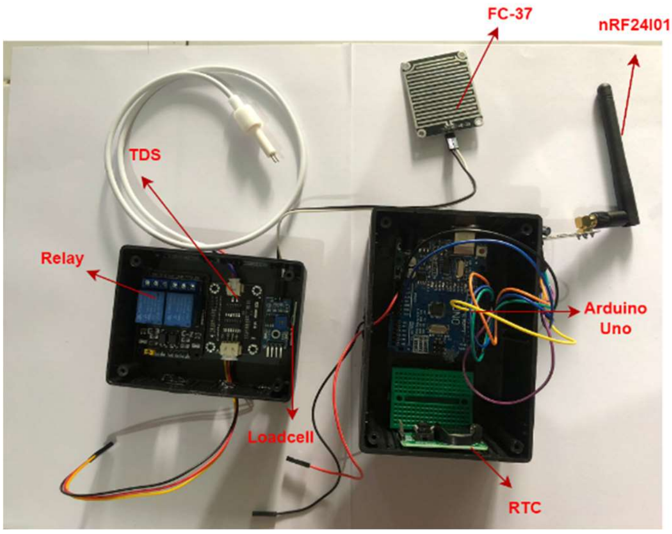

Fig. 7 Circuit on Node Sensor

At the sensor node, there are TDS sensors which function to measure the level of pond turbidity, FC-37 sensors which function to detect rain, servos to move feed reservoirs, RTC sensors which function to regulate feeding schedules, loadcell as a detector of feed availability, and cleaners. pump as a pump to lift impurities to the biofloc reservoir. All of these sensors will be connected to the Arduino uno to store sensor data. Then there is the nRF24l01 communication module to transmit data from the sensor node to the server.

C. *Web System Testing*

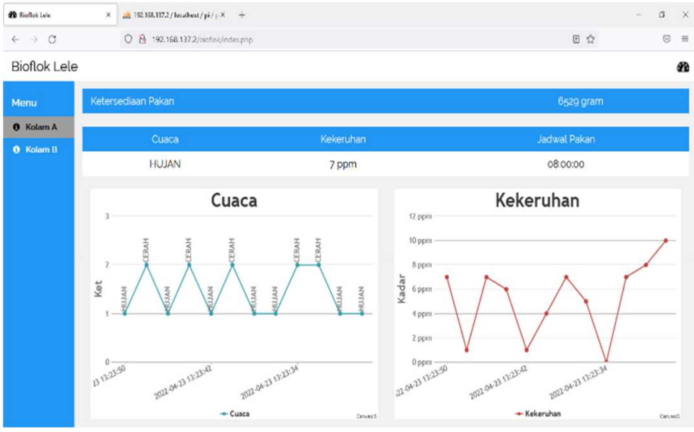

Fig. 8 web server main view

This web page displays, among others, showing the monitoring of weather conditions in each catfish pond, the level of turbidity in each fish pond, the availability of feed, and the feeding schedule.

D. *Implementation of Sensor Node Software*

The following is the implementation of the software program for sending data from the sensor node to the server.

Fig. 9 sensor node coding display

Shows the software implementation in the sensor node section, where there is a library for data transmission commands with the nRF24l01 wireless communication module. For the nodeID part, it functions as the identity owner for each node by setting the node address. An octect calculator is needed because the address system on arduino is an octect then the ID is based on the conversion to decimals as the ID address value.

E. *Testing Sensor Node Connection with Server*

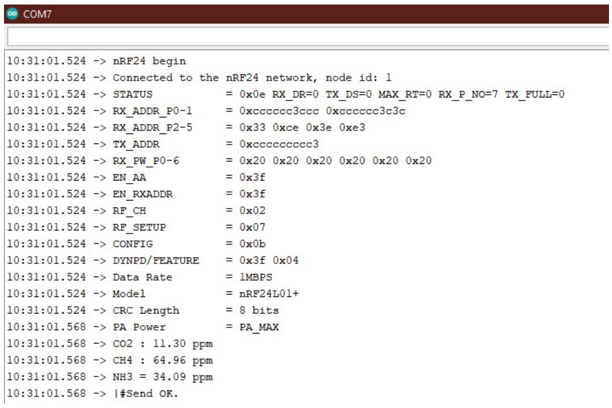

Fig. 10 Serial Monitor Display

Testing the connection between the sensor node and the server is carried out in order to determine the success rate of communication made on Arduino Uno via nRF24L01 and Raspberry Pi via nRF24L01 using the point to point test method. Point to point testing is a test where 1 node becomes the transmitter and 1 node becomes the receiver. The connection result from the sensor node will display the result "#Send OK" then if the sensor node can connect to the server and the data is sent successfully.

F. *Testing nRF24L01 on Line of Sight*

Testing the nRF24L01 communication module on Line of Sight conditions located at a catfish pond cultivator can work well. With conditions in the open and without any obstacles between the communication module nRF24L01, as shown in Table I.

TABLE I
LINE OF SIGHT CONDITIONS

Distance (m)	Packages sent	Packages received	Packet loss (%)	Delay (Second)
10	50	50	0	0.23
20	50	50	0	0.50
30	50	50	0	0.97
40	50	50	0	1.20
50	50	50	0	1.46
60	50	49	2	2.45
70	50	49	2	2.83
80	50	48	4	3.30
90	50	48	4	3.69
100	50	47	6	4.10
110	50	45	12	5.26
120	50	43	14	6.25
130	50	-	-	-

Can be seen that the maximum communication distance can reach 120 meters with the number of packet loss and delays that increase along with the increase in the communication distance between the sensor node and the server node. At a test distance of 130 meters the module cannot communicate.

G. *Condition Test Results on Sensor Node*

Data retrieval is taken for 5 days where the data displayed is the result of testing the condition of sensor nodes 1 and 2. Where data collection hours are carried out at 8.00 and 15.00 according to the test design on the research method, as shown in Table II and Table III.

TABLE II
NODE SENSOR 1

No	Date	Loadcell (kg)	TDS	Sensor FC-37	Time
1.	13/06/2022	3.0	159	Sunny	08.00
2.	13/06/2022	2.6	159	Sunny	15.00
3.	14/06/2022	2.0	180	Sunny	08.00
4.	14/06/2022	2.0	181	Rain	15.00
5.	15/06/2022	1.4	183	Sunny	08.00
6.	15/06/2022	1.4	200	Rain	15.00
7.	16/06/2022	1.0	230	Sunny	08.00
8.	16/06/2022	3.7	252	Sunny	15.00
9.	17/06/2022	3.2	180	Sunny	08.00
10	17/06/2022	2.7	180	Rain	15.00

TABLE III
NODE SENSOR 2

No	Date	Loadcell (kg)	TDS	Sensor FC-37	Time
1.	13/06/2022	3.7	200	Sunny	08.00
2.	13/06/2022	3.1	203	Sunny	15.00
3.	14/06/2022	2.5	237	Sunny	08.00
4.	14/06/2022	2.5	238	Rain	15.00
5.	15/06/2022	2.0	247	Sunny	08.00
6.	15/06/2022	2.0	247	Rain	15.00
7.	16/06/2022	1.6	275	Sunny	08.00
8.	16/06/2022	0,9	200	Sunny	15.00
9.	17/06/2022	3.0	215	Sunny	08.00
10	17/06/2022	2.6	215	Rain	15.00

H. Testing the Success Rate of Data Delivery On System

The parameter for testing the success rate of data transmission used is Qos (Quality Of Service), including Packet Loss and Delay. The test results in each QOS will be shown in table 4 and 5 as below.

1) Packet Loss: Packet Loss Test aims to determine the percentage of the number of lost packets that can occur due to collisions and congestion on the network. There are 10 samples shown in Table IV.

TABLE IV
PACKET LOSS

package delivery	package sent	Paket Error	Category
1.	8	0	Good
2.	12	1	Good
3.	14	0	Good
4.	16	2	Good
5.	10	1	Good
6.	9	0	Good
7.	15	1	Good
8.	7	1	Good
9.	12	0	Good
10	12	0	Good

From the results of the calculations that have been carried out, the packet loss value obtained when testing is 5.2%. The value obtained above shows that the packet loss value obtained has a low range value. According to ITU-T G. 144 the values obtained in the above test are included in the range of values in the medium category.

2) Delay : Delay testing aims to determine the time it takes the data to travel the distance from origin to destination. Delay itself can be affected by distance, physical media, congestion or also a long processing time.

TABLE V
DELAY TEST

No	Source	Destination	Delay (S)
1	192.168.137.9	35.201.97.85	0.260168
2	192.168.137.9	35.201.97.85	0.262961
3	192.168.137.9	35.201.97.85	0.256718
4	192.168.137.9	35.201.97.85	0.252209
5	192.168.137.9	35.201.97.85	0.259722
6	192.168.137.9	35.201.97.85	0.260142
7	192.168.137.9	35.201.97.85	0.295577
8	192.168.137.9	35.201.97.85	0.258432
9	192.168.137.9	35.201.97.85	0.252319
10	192.168.137.9	35.201.97.85	0.251753
		average	0.2610001

In Table V, the delay test is carried out with 10 sample packets to be searched for the average of the delay. From the calculation of the resulting packet - the average delay obtained is 0.261001 seconds and is included in the good category according to ITU-T G.114. The smaller the delay, the better the quality of a data transmission because there will be no delay in information.

I. Overall Discussion of System Testing Results

All systems that have been designed are then tested which includes the level of accuracy of the installed TDS, Loadcell, and Fc-37 sensors by comparing them with actual measuring instruments. Then tested the value of the distance from the sensor node to the server node with the nRF24L01 communication module. To find out the environmental conditions of the catfish pond with the biofloc system, it can be seen through the web server, the information contained on the web server includes the level of turbidity of the pond, the condition of the availability of feed, and weather conditions. All information will be updated in real time. Based on the results of the tests that have been carried out, the overall results can be seen in the Table VI.

TABLE VI.
TESTING THE WHOLE SYSTEM

No.	Testing Process	succes	not succes
1.	TDS meter accuracy	✓	-
2.	Loadcell Accuracy	✓	-
3.	Accuracy Fc-37	✓	-
4.	Testing distance nRF24L01	✓	-
5.	Data transmission by sensor node	✓	-
6.	Receipt of data by server	✓	-
7.	Display data on the Web server	✓	-
8.	Testing packet loss	✓	-
9.	Testing delay	✓	-

IV. CONCLUSION

Based on the background, problem formulation, planning and implementation, it can be obtained from this research that: The results of the design and implementation that have been carried out can be concluded or known that automatic feeding of catfish using the biofloc system method is more efficient than ordinary conventional methods, and automatic feeding arrangements can run as planned. To find out the environmental conditions of the catfish pond with the biofloc system, it can be seen through the web server, the information contained on the web server includes the level of turbidity of the pond, the condition of the availability of feed, and weather conditions. All information will be updated in real time. The results of communication using nRF24l01 between sensor nodes to the server as far as 15 meters with an average delay of 0.26 seconds and packet loss of 5.2%. The test results between the sensor nodes to the server obtained a delay of 0.26 seconds which is included in the good category, then for packet loss a value of 5.2% is found in the medium category.

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