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An Implementation of Fuzzy Logic to Salinity Control of Chanos chanos Pond Based on Internet of Things

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Abstract---*Chanos chanos has great potential to become a business field in Indonesia. To manage a farm many factors must be considered, one of the factors that must be managed well is Water Salinity. At present in Tanjungpakis - Karawang Village, pond farmers still use traditional methods to find out the condition of pond water. Farmers do it by looking at the color of water, the smell of water and using taste buds. Generally brackish chanos chanos can grow well in water conditions that have saline levels ranging from 5 - 25 ppt. With changing environmental conditions and weather, the salinity of ponds usually increases or decreases, during the dry season the pond water salinity usually increases quite dramatically, whereas in the rainy season the pond's water salinity is usually at normal or even less normal limits. Farmers in the pond do additional fresh water in the dry season and increase sea water in the rainy season so that the pond's water salinity remains stable. this study made a water salinity control system for chanos chanos fishponds. The control system is carried out by measuring the salinity of pond water using conductivity sensors, processing data using fuzzy logic, direct monitoring through computers and mobile phones and using aquaculture, namely freshwater and sea water pumps to maintain the stability of salt levels in the ponds. This system runs well with an accuracy rate of 87.8% compared to refractor meter and condition determination using fuzzy logic with 100% accuracy.*

Keyword---*Conductivity, Salinity, Fuzzy Logic, Internet of Things.*

I. Introduction.

Chanos chanos or milkfish besides being a nutritional value food, it has also become a good export commodity. To achieve this quality, one of which is to maintain the salinity of the pond, the salinity of the pond water affects the level of metabolic rate, activity, growth and osmoregulation (Swanson, 1998). Pond water salinity affects the growth of bacteria and algae (Chang, Chang, Chao, Yeh, & Kuo, 2019).

The theory of fuzzy logic is based on fuzzy set theory, which is a natural extension of classical set theory (Mitchell, n.d.). Fuzzy logic is used to classify and evaluate infectious diseases (Arji et al., 2019). fuzzy logic to evaluate river water quality (Golshan, Dastoorpour, & Birgani, 2020). The algorithm used to measure pond water salinity is using fuzzy logic, fuzzy logic is widely used, one of which is to measure the temperature and humidity conditions in a greenhouse in agriculture with a low percentage of errors (Ben, Bouadila, & Mami, 2018), to evaluate the sustainability of groundwater

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systems in several cities in Asia and the results are better than other methods (Tirupathi, Shashidhar, Pandey, & Shrestha, 2018; Hussain et al., 2019).

The use of the technology of the Internet of Things is very necessary to offset the increasing demand for food products because of the rapidly increasing population growth, the application of this technology is the key to achieving smart agriculture, so farmers can monitor in real time (Sinha, Shrivastava, & Kumar, 2019). internet of things is used to share information, sensor data in smart cities (Jiang, 2019).

This system is able to measure and control the conditions of pond water salinity in good conditions for chanos chanos, the data obtained is sent to the web server so that farmers can monitor directly.

II. Data and Methode

Hardware Design

The process begins with reading the condition of the pond's salinity with a conductivity sensor, the reading data is processed using the Fuzzy logic method on the microcontroller to determine the conditions of low, medium or high pond water salinity.

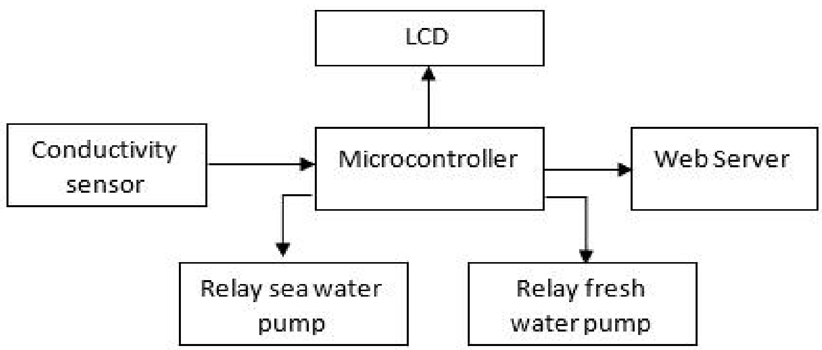

Figure 1:Hardware Design

freshwater pump relays and seawater pump relays will operate in accordance with the conditions generated by the fuzzy logic process on the microcontroller, if the conditions of salinity are low then the seawater pump relay will turn on while if the conditions are high then the freshwater pump relay will turn on, the system's purpose is to condition the pond water under moderate conditions of salinity. the process results are displayed on the LCD and data is sent to the web server.

Software Design

In this section, the important part of forming the system, the application of the fuzzy logic method is used to determine the condition of the pond's salinity.

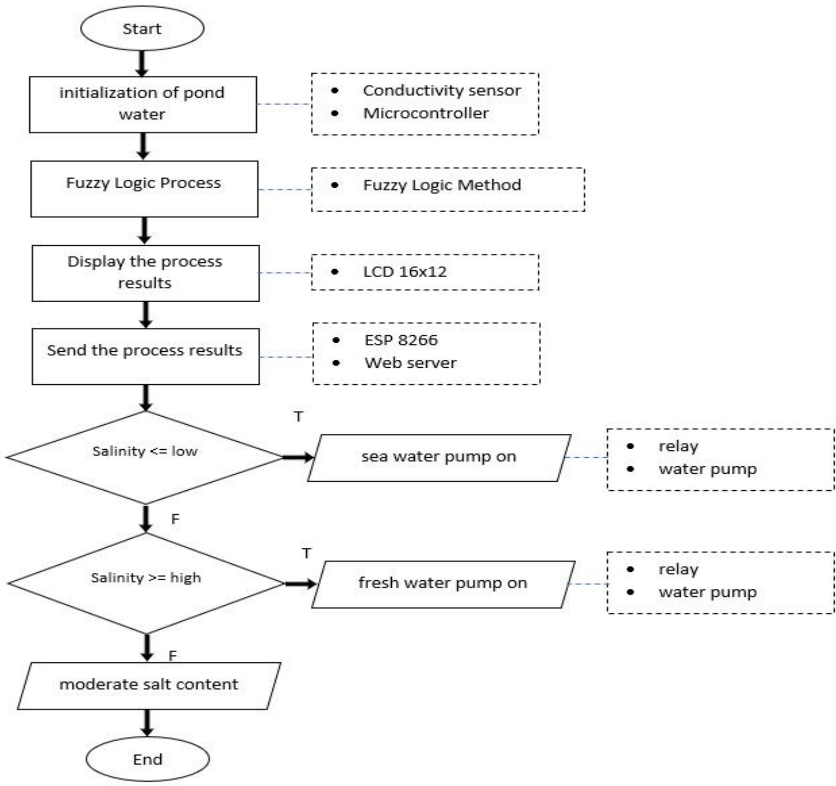

Figure 2: Software Design

a) Initialization of pond water, the conductivity sensor reads the salt content in the form of electrical voltage sent to the microcontroller to be processed by the fuzzy logic method.
b) Fuzzy logic Process, Fuzzy logic is used to determine the condition of the salt water content of the pond.
c) Display the process results, the results of the fuzzy logic process on the 2x16 LCD display.
d) If the salt content is low, the seawater pump relay is active with the aim of adding salinity to the pond water.
e) If the salt content is low, the freshwater pump relay is active with the aim of reducing salinity in the pond water.

Fuzzy logic

determination of setpoint, setpoint is a grouping of numbers that will be used as a determinant where the results of reading the salt level have a low, medium, or high condition. As explained in the previous chapter, the salinity is good at 5-25 ppt (Swanson, 1998).

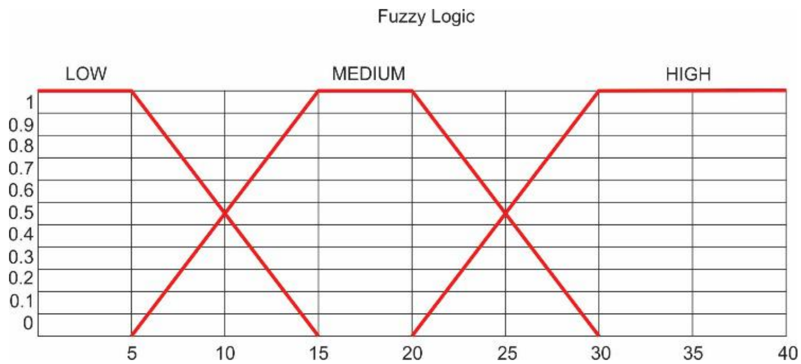

Figure 3: Membership Function of Salinity

a) Low Salinity

FuzzySet *low = new FuzzySet(0, 0, 5, 15);

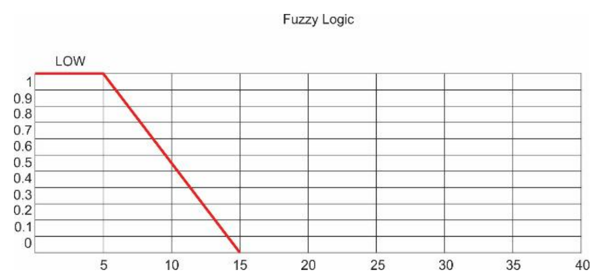

Figure 4: Membership Function of Low Salinity

b) Medium Salinity

FuzzySet *medium = new FuzzySet(5, 15, 20, 30);

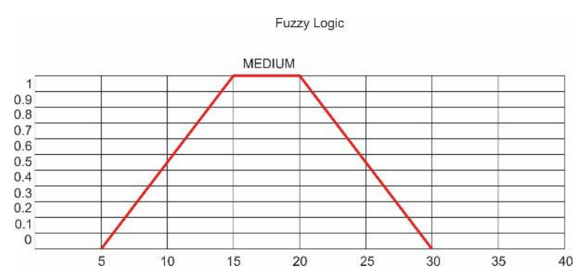

Figure 5: Membership Function of Medium Salinity

c) High Salinity

FuzzySet *high = new FuzzySet(20, 30, 40, 40);

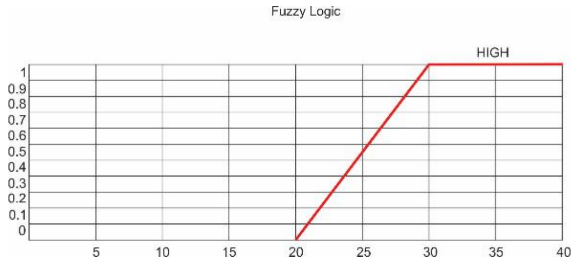

Figure 6:Membership Function of High Salinity

III. Result and Discussion

Tests carried out using 30 samples. This test is carried out on the farm to determine the performance of the system, and below is the result of reading the Salinity system compared to a refractometer (Prakash et al., 2019).

Table 1: Testing Tool with Refractometer

No	Conductivity sensor reading results	Refractometer results	Difference Remarks (Refractometer x System)	Fuzzy Logic			Fuzzy Logic Results	Description
				low	middle	high		
1	2,86	3,00	5%	**0,89**	0,11	0,00	low	true
2	4,44	6,00	26%	**0,54**	0,46	0,00	low	true
3	8,98	10,00	10%	0,32	**0,68**	0,00	middle	true
4	11,12	12,00	7%	0,18	**0,82**	0,00	middle	true
5	13,47	15,00	10%	0,08	**0,92**	0,00	middle	true
6	17,50	19,00	8%	0,00	**0,89**	0,11	middle	true
7	18,96	20,00	5%	0,00	**0,78**	0,22	middle	true
8	22,03	24,00	8%	0,00	**0,66**	0,34	middle	true
9	25,24	27,00	6%	0,00	**0,53**	0,47	middle	true
10	26,57	28,00	5%	0,00	0,13	**0,87**	high	true
11	2,33	4,00	42%	**0,90**	0,10	0,00	low	true
12	4,35	5,00	13%	**0,67**	0,33	0,00	low	true
13	6,37	8,00	20%	0,41	**0,59**	0,00	middle	true
14	8,70	10,00	13%	0,32	**0,68**	0,00	middle	true
15	10,77	13,00	17%	0,26	**0,74**	0,00	middle	true
16	13,32	15,00	11%	0,00	**0,89**	0,11	middle	true
17	16,53	19,00	13%	0,00	**0,80**	0,20	middle	true
18	19,31	22,00	12%	0,00	**0,71**	0,29	middle	true
19	22,47	25,00	10%	0,00	**0,61**	0,39	middle	true
20	26,12	28,00	7%	0,00	0,12	**0,88**	high	true
21	1,93	2,00	3%	**0,89**	0,11	0,00	low	true
22	3,82	4,00	4%	**0,54**	0,46	0,00	low	true
23	5,36	7,00	23%	0,32	**0,68**	0,00	middle	true
24	8,31	10,00	17%	0,18	**0,82**	0,00	middle	true
25	10,29	13,00	21%	0,08	**0,92**	0,00	middle	true
26	13,15	16,00	18%	0,00	**0,89**	0,11	middle	true
27	15,04	17,00	12%	0,00	**0,81**	0,19	middle	true
28	17,68	19,00	7%	0,00	**0,76**	0,24	middle	true
29	21,86	23,00	5%	0,00	**0,69**	0,31	middle	true
30	24,36	26,00	6%	0,00	**0,56**	0,44	middle	true

Based on testing, there are two conclusions:

1. **Comparison of systems with refractometer devices.**

$$\boldsymbol{Accuracy}(\%) = 100 - \frac{\boldsymbol{sum\ of\ difference\ remarks}}{\boldsymbol{N}}\ \boldsymbol{x}\ \mathbf{100}\%$$

$$\boldsymbol{Accuracy}(\%) = 100 - \frac{\mathbf{364}}{\mathbf{30}}\ \boldsymbol{x}\ \mathbf{100}\%\boldsymbol{Accuracy}(\%) =\ \mathbf{87{,}8}\%$$

$$\boldsymbol{Accuracy}(\%) = \mathbf{87{,}8}\%$$

2. Fuzzy logic results

$$\boldsymbol{Accuracy}(\%) = \frac{\boldsymbol{sum\ of\ true\ value}}{\boldsymbol{N}}\ \boldsymbol{x}\ \mathbf{100}\%$$

$$\boldsymbol{Accuracy}(\%) = \frac{\mathbf{30}}{\mathbf{30}}\ \boldsymbol{x}\ \mathbf{100}\%$$

$$\boldsymbol{Accuracy}(\%) = \mathbf{100}\%$$

IV. Conclusion Future Work

Based on testing conducted on the manufacture of chanos chanos pond salinity control tools with the Internet-based Fuzzy logic method are:

1. The sensor reading compared to the refractometer produces an accuracy of 87.8%.
2. Sensor readings after being processed with Fuzzy logic result in compatibility up to 100%.

To improve the comparison of refractor meters, sensors must have a higher precision.

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