MEASUREMENT OF IRRIGATION WATER QUALITY USING FUZZY METHOD INFERENCE SYSTEM

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In this final project, a water quality measuring system based on an integrated IoT sensor will be designed. In water quality measurement technology which is still conventional, there are often obstacles in collecting data from quality, as well as dependence on human labor in operating these conventional tools. This becomes important to develop, considering water quality is an important factor in the development and productivity of a plant.

With the integrated IoT sensor system, it can make it easier to measure field data, and provide a more effective water quality measurement system, because it can be done at long distances, and without cable intermediaries. Other reasons for using IoT-integrated sensor technology include flexibility in remote communication from the point of location of the sensor and continuous improvement in overall accuracy (real-time). In this research, the application of the irrigation water quality measurement system uses the fuzzy inference system method which produces an accuracy value of 100%.

Keywords: IoT, water quality, plant development and productivity, integrated sensor system.

I. INTRODUCTION

Water is very important for the survival of living things in this world. So in other words, water is a very valuable thing. Air can be used for purposes in various fields, for example for daily use for air transportation, electricity generation for irrigation purposes. In other words, air can bring the welfare of humans and other living things. In everyday life we often find rice fields or plantations that are located adjacent to industrial areas. This is to monitor the contamination of agricultural products through industry in irrigation water sources. [1]

Agricultural activities have a reciprocal relationship with air quality. Unwise agricultural activities can reduce the quality of the air around it and its downstream areas. On the other hand, to get quality agricultural products and safe for consumption by certain air quality. Thus, the sustainability of the agricultural sector is highly dependent on the presence of water in terms of quality and quantity.

Technology is applied to simplify and simplify every means necessary for human survival. Indirectly, technology has reduced human interaction in several routine activities carried out. The rapidly increasing technological development and its application in all fields can be a solution to human problems, one of which is the problem in agriculture. Therefore, the drinking water quality detector will be made using sensors with Arduino as the controller, integrated with the internet network and using the Android application facility as the user interface.

Identify applicable funding agency here. If none, delete this text box.

II. RESEARCH METHOD

A. Fuzzy Logic

Fuzzy Logic is a branch of Artificial Intelligence, which is knowledge that enables computers to imitate human intelligence so that computers are expected to do things that when humans need intelligence. In other words, fuzzy logic has a function to "imitate" the intelligence possessed by humans to do something and implement it into a device, for example robots, vehicles, household appliances, and others. In the journal [9], it is explained about the use of fuzzy logic to determine the condition of how much sensor data is obtained which can then be made a future prediction.

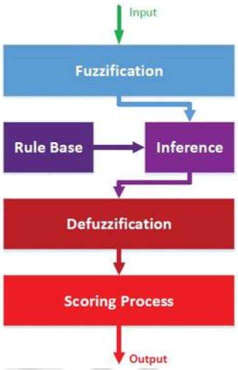

Fig 1 Fuzzy Logic Process

In Fig 1 it is explained that fuzzy logic has several stages before the results of the data processing process are processed into a result condition. Fuzzy Logic has the following stages:

1. Fuzzification: This stage is used to determine the inference value. At this stage the incoming data will be determined in value to be processed by the rules that have been determined.
2. Rules and Inference: The values that have been obtained will then be processed all of the inferences values.
3. Defuzzification: This process is performed to return the value to be returned to the final value.
4. Scoring Process: In this process the value of the fuzzy logic results will be obtained from the defuzification process.

III. PROPOSED FEATURE EXTRACTION

A. Fuzzy Logic Design

- Fuzzy Logic Set Formation

a) Temperature

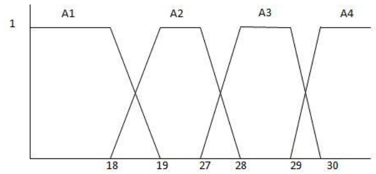

Fig 2 Temperature Membership Function

From Figure 2 it can be seen that the membership function of temperature, from the membership graph, the following equation can be obtained.

Information:

A1: It's so cold

A2: It's cold

A3: Normal

A4: Hot

$$A1 \begin{cases} 0 \,;\, x \ge 19 \\ \frac{19-x}{19-18} \,;\, 18 < x < 19 \\ 1 \,;\, x \le 18 \end{cases} \quad \ldots\ldots\ldots\ldots (3.1)$$

$$A2 \begin{cases} 0 \,;\, x \le 18 \text{ atau } x \ge 28 \\ \frac{x-18}{19-18} \,;\, 18 \le x \le 19 \\ \frac{28-x}{28-27} \,;\, 27 < x < 28 \\ 1 \,;\, 19 < x < 27 \end{cases} \quad \ldots\ldots\ldots\ldots (3.2)$$

$$A3 \begin{cases} 0 \,;\, x \le 27 \text{ atau } x \ge 30 \\ \frac{x-27}{28-27} \,;\, 27 \le x \le 28 \\ \frac{30-x}{30-29} \,;\, 29 < x < 30 \\ 1 \,;\, 28 < x < 29 \end{cases} \quad \ldots\ldots\ldots\ldots (3.3)$$

$$A4 \begin{cases} 0 \,;\, x \le 29 \\ \frac{x-29}{30-29} \,;\, 29 < x < 30 \\ 1 \,;\, x \ge 30 \end{cases} \quad \ldots\ldots\ldots\ldots (3.4)$$

b) pH

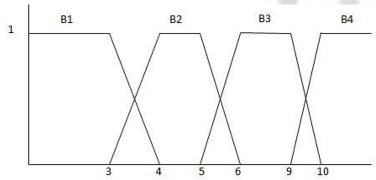

Fig 3 PH Membership Functions

From Figure 3 it can be seen the membership function of pH, from the membership graph, the following equation is obtained.

Information:

B1: It's so sour

B2: Acid

B3: Normal

B4: Basa

$$B1 \begin{cases} 0 \,;\, x \ge 4 \\ \frac{4-x}{4-3} \,;\, 3 < x < 4 \\ 1 \,;\, x \le 3 \end{cases} \quad \ldots\ldots\ldots\ldots (3.5)$$

$$B2 \begin{cases} 0 \,;\, x \le 3 \text{ atau } x \ge 6 \\ \frac{x-3}{4-3} \,;\, 3 \le x \le 4 \\ \frac{6-x}{6-5} \,;\, 5 < x < 6 \\ 1 \,;\, 4 < x < 5 \end{cases} \quad \ldots\ldots\ldots\ldots (3.6)$$

$$B3 \begin{cases} 0 \,;\, x \le 5 \text{ atau } x \ge 10 \\ \frac{x-5}{6-5} \,;\, 5 \le x \le 6 \\ \frac{10-x}{10-9} \,;\, 9 < x < 10 \\ 1 \,;\, 6 < x < 9 \end{cases} \quad \ldots\ldots\ldots\ldots (3.7)$$

$$B4 \begin{cases} 0 \,;\, x \le 9 \\ \frac{x-9}{10-9} \,;\, 9 < x < 10 \\ 1 \,;\, x \ge 10 \end{cases} \quad \ldots\ldots\ldots\ldots (3.8)$$

c) Dissolved Solids

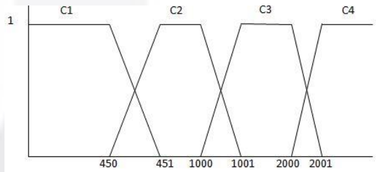

Fig 4 Dissolved Solids Membership Function

From Figure 4 it can be seen that the membership function of Dissolved Solids, from the membership graph, the following equation is obtained.

Information:

C1: Very good

C2: Fine

C3: Moderate

C4: Bad

$$C1 \begin{cases} 0 \,;\, x \ge 451 \\ \frac{451-x}{451-450} \,;\, 450 < x < 451 \\ 1 \,;\, x \le 450 \end{cases} \quad \ldots\ldots\ldots\ldots (3.9)$$

$$C2 \begin{cases} 0 \,;\, x \le 450 \text{ atau } x \ge 1001 \\ \frac{x-450}{451-450} \,;\, 450 \le x \le 451 \\ \frac{1001-x}{1001-1000} \,;\, 1000 < x < 1001 \\ 1 \,;\, 451 < x < 1000 \end{cases} \quad \ldots\ldots\ldots\ldots (3.10)$$

$$C3 \begin{cases} 0 \,;\, x \le 1000 \text{ atau } x \ge 2001 \\ \frac{x-1000}{1001-1000} \,;\, 1000 \le x \le 1001 \\ \frac{2001-x}{2001-2000} \,;\, 2000 < x < 2001 \\ 1 \,;\, 1001 < x < 2000 \end{cases} \quad \ldots\ldots\ldots\ldots (3.11)$$

$$C4 \begin{cases} 0 \,;\, x \le 2000 \\ \frac{x-2000}{2001-2000} \,;\, 2000 < x < 2001 \\ 1 \,;\, x \ge 2001 \end{cases} \quad \ldots\ldots\ldots\ldots (3.12)$$

d) Turbidity

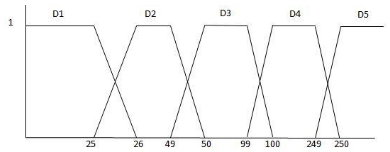

Fig 5 Turbidity Membership Function

From Figure 5, it can be seen that the membership function of Turbidity, from the membership graph, the following equation can be obtained.

Information:

D1: It's very clear

D2: Clear

D3: Self-explanatory

D4: cloudy

D5: It's so cloudy

$$D1 \begin{cases} 0 ; x \geq 26 \\ \frac{26-x}{26-25} ; 25 < x < 26 \\ 1 ; x \leq 25 \end{cases} \quad \text{..............} (3.13)$$

$$D2 \begin{cases} 0 ; x \leq 25 \text{ atau } x \geq 50 \\ \frac{x-25}{26-25} ; 25 \leq x \leq 26 \\ \frac{50-x}{50-49} ; 49 < x < 50 \\ 1 ; 26 < x < 49 \end{cases} \quad \text{..............} (3.14)$$

$$D3 \begin{cases} 0 ; x \leq 49 \text{ atau } x \geq 100 \\ \frac{x-49}{50-49} ; 49 \leq x \leq 50 \\ \frac{100-x}{100-99} ; 99 < x < 100 \\ 1 ; 50 < x < 99 \end{cases} \quad \text{..............} (3.15)$$

$$D4 \begin{cases} 0 ; x \leq 99 \text{ atau } x \geq 250 \\ \frac{x-99}{100-99} ; 99 \leq x \leq 100 \\ \frac{250-x}{250-249} ; 249 < x < 250 \\ 1 ; 100 < x < 249 \end{cases} \quad \text{..............} (3.16)$$

$$D5 \begin{cases} 0 ; x \leq 249 \\ \frac{x-249}{250-249} ; 249 < x < 250 \\ 1 ; x \geq 250 \end{cases} \quad \text{..............} (3.17)$$

B. *Knowledge Base (Rules)*

Fuzzy knowledge base is a collection of fuzzy rules in the form of IF… THEN statements. There are 320 rules, namely:

Tabel 1 Rules table used

NO	SUHU	KEASAMAN	TDS	KEKERUHAN	KUALITAS
1	A1	B1	C1	D1	P2
2	A1	B1	C1	D2	P2
3	A1	B1	C1	D3	P3
4	A1	B1	C1	D4	P3
5	A1	B1	C1	D5	P3
6	A1	B1	C2	D1	P3
7	A1	B1	C2	D2	P3
8	A1	B1	C2	D3	P3
9	A1	B1	C2	D4	P3
10	A1	B1	C2	D5	P3
11	A1	B1	C3	D1	P3
12	A1	B1	C3	D2	P3
13	A1	B1	C3	D3	P3

Compiled by:

- ASSESSMENT OF IRRIGATION WATER QUALITY CRITERIA.
- Republic of Indonesia, Government Regulation no. 20 of 1990 concerning Water Pollution Control.
- Republic of Indonesia, Government Regulation no. 20 of 2006 concerning Irrigation.
- Republic of Indonesia, Government Regulation no. 82 of 2001 concerning Management of Water Quality and Control of Water Pollution.
- Republic of Indonesia, Law no. 32 of 2009 concerning Environmental Protection and Management.
- Republic of Indonesia, Law no. 7 of 2004 concerning Water Resources.

Validated by:

- Environmental Lab, Bandung Institute of Technology.
- Setia Budi Water Quality Lab.
- Ornamental Plants & Tambulampot (Fruit Plants in Pot) Business Actors.
- Farmers of Sukabirus, Bojongsoang, Kab. Bandung West Java.

C. *Inference - Mamdani*

Inference is an evaluation stage of fuzzy rules. The evaluation stage is carried out based on reasoning using fuzzy input and fuzzy knowledge base (fuzzy rule base) in order to obtain the output in the form of a fuzzy set. In this study the authors used the Mamdani inference method, where the Mamdani method is often called the MIN-MAX method because this method uses the min implication function and max aggregation. the output for the n rules of the Mamdani method is defined as follows:

$$\mu_{B^k}(y) = \max[\min[\mu A_1^k(x_i), \mu A_2^k(x_j)]]_k \quad \text{..............} (3.18)$$

D. *Defuzzifikasi*

Defuzzification is the opposite of the fuzzification process where defuzzification is changing the fuzzy set to a crisp (firm) value as the final result. In this defuzzification process the author uses the Centroid method or what is often called the Center of Gragity. The Mamdani method uses the average (average) in the following general form:

$$y* = \frac{\sum y \mu_R(y)}{\sum \mu_R(y)} \quad \text{...............} (3.19)$$

E. *Interface Design Based on Android*

In monitoring water quality and data collection on the impact of water quality on plants, an interface is needed that can connect hardware, systems, and users. Therefore, the authors designed an Android-based interface in order to facilitate use and the monitoring process. Android as the interface was also chosen because of the mobility of Android which can be accessed anywhere via a device connected to the internet network. Android will work based on the data flow diagram (DFD) below:

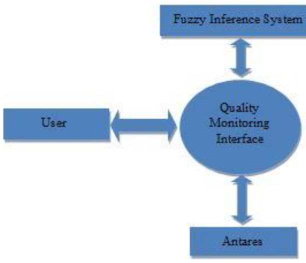

Fig 6 Data Flow Diagram Level 0 Designing Android

IV. RESULTS AND ANALYSIS

A. Experimental Results

The experiment was carried out in several stages, namely testing the output of rules, testing synchronization of rules, manual testing and analysis through plant trials.

a) Testing Rules

In this test, a procedure will be carried out by checking each rule using the main page as the medium. The way this test works is to match the input and output of each rule whether it is in accordance with the rules owned by the fuzzy inference system.

Tabel 2 Rules check table

No	Suhu	Keasaman	TDS	Kekeruhan	Kualitas	Cek
1	A1	B1	C1	D1	P2	Sesuai
2	A1	B1	C1	D2	P2	Sesuai
3	A1	B1	C1	D3	P3	Sesuai
4	A1	B1	C1	D4	P3	Sesuai
5	A1	B1	C1	D5	P3	Sesuai
6	A1	B1	C2	D1	P3	Sesuai
7	A1	B1	C2	D2	P3	Sesuai
8	A1	B1	C2	D3	P3	Sesuai
9	A1	B1	C2	D4	P3	Sesuai
10	A1	B1	C2	D5	P3	Sesuai
11	A1	B1	C3	D1	P3	Sesuai
12	A1	B1	C3	D2	P3	Sesuai

b) Synchronization Testing

In this test, a comparison will be made between the input data in the main menu and the calculator, whether using the same input value will get the same output between the two features. In this process, the test will be repeated 50 (fifty) times to increase the accuracy value.

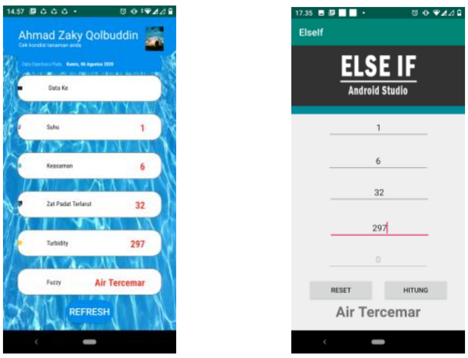

Fig 7 Synchronization Testing

c) Alpha Testing

a. Testing Objectives Alpha

Alpha testing is the first stage of testing a software where the goal is to test the feasibility of an application by testing the functionality of the features contained in the application.

b. Alpha Testing Scenarios

In the application of measuring the quality of irrigation water using the Fuzzy Inference System method, the functionality testing of the features of the application will be tested. Here is a test scenario

Tabel 3 Alpha Testing Scenarios

No	Menu yang diuji	Detail pengujian	Jenis pengujian
1	Membuka Aplikasi	Menampilkan splash screen.	*Black box*
		Menampilkan data terkini.	*Black box*
		Menampilkan data Sensor suhu, sensor pH, sensor TDS, sensor Turbidity.	*Black box*
2	Klasifikasi Logika Fuzzy	Menampilkan hasil kualitas air irigasi.	*Black box*
3	Membuka menu kalkulator pengukuran kualitas air irigasi	Menampilkan kolom input manual	*Black box*
4	Klasifikasi Logika Fuzzy Kalkulator	Menampilkan hasil kualitas air irigasi.	*Black box*

c. Alpha Testing Results

The results of alpha testing Irrigation Water Quality Measurement Using the Fuzzy Inference System Method can be seen in the table below:

Tabel 4 Testing Results Opening Applications

No	Data Masukan	Hasil yang diharapkan	Hasil Pengamatan	Kesimpulan
1	Membuka Aplikasi	Menampilkan splash screen.	Dapat menampilkan splash screen.	Berhasil
		Menampilkan data terkini.	Dapat menampilkan data terkini.	Berhasil
		Menampilkan data Sensor suhu, sensor pH, sensor TDS, sensor Turbidity.	Dapat menampilkan data Sensor suhu, sensor pH, sensor TDS, sensor Turbidity ketika tombol *refresh* berhasil di klik.	Berhasil

Table 4 shows that the test opens the application successfully and is in accordance with the expected results.

Tabel 5 Fuzzy Logic Classification

No	Data Masukan	Hasil yang diharapkan	Hasil Pengamatan	Kesimpulan
2	Klasifikasi Logika Fuzzy	Menampilkan hasil kualitas air irigasi.	Dapat menampilkan hasil kualitas air irigasi ketika tombol *refresh* berhasil di klik.	Berhasil

Table 5 shows that the fuzzy logic classification test is successful and in accordance with the expected results.

Tabel 6 Opens the Calculator Menu

No	Data Masukan	Hasil yang diharapkan	Hasil Pengamatan	Kesimpulan
3	Membuka menu kalkulator pengukuran kualitas air irigasi	Menampilkan kolom input manual	Dapat menampilkan kolom input manual dan dapat menginputkan data secara manual.	Berhasil

Table 6 shows that the manual input fields can be displayed.

Tabel 7 Fuzzy Logic Classification Calculator

No	Data Masukan	Hasil yang diharapkan	Hasil Pengamatan	Kesimpulan
4	Klasifikasi Logika Fuzzy Kalkulator	Menampilkan hasil kualitas air irigasi.	Dapat menampilkan hasil kualitas air irigasi ketika tombol hitung berhasil di klik.	Berhasil

Table 7 shows that the calculator fuzzy logic classification can be displayed.

d) Beta Testing

a. Beta Testing Scenarios

Beta testing is a test that is carried out objectively by measuring the usability of the system where the system will be used and interact directly with users. Usability testing uses the USE (Usefulness, Satisfaction, Ease of Use) questionnaire to measure aspects of usability, satisfaction and ease of use of users in using the application. This questionnaire consists of 9 questions that contain 5 aspects in usability testing, namely:

- Learnability, explains the level of ease with which users can use functionality and complete tasks when the user first interacts with the application.
- Efficiency, describes how fast the user can complete a task when the user first uses the application.
- Merorability, describes the level of ease with which users can use the application properly, after not using it for a while.
- Errors, describes the possibility of errors or errors made by users and how young they can handle them.
- Satisfaction, describes the level of user satisfaction in using the application. Usability testing task scenarios can be seen in the table below:

Usability testing task scenarios can be seen in the table below:

Tabel 8 Usability Testing Task Force

No	*Task* / Tugas
1	Membuka aplikasi dan perhatikan tampilan halaman utama.
2	Menekan tombol *refresh* untuk menampilkan data dari Antares.
3	Membuka menu kalkulator pengukuran kualitas air irigasi.
4	Menginputkan data dan menekan tombol hitung.
5	Menekan tombol *reset* untuk menghapus inputan manual pada menu kalkulator.

b. Beta Testing Results

Beta testing on the Irrigation Water Quality Measurement application provides 9 questions with an example of information as follows:

1. Very Hard (score = 1)
2. Difficult (score = 2)
3. Quite easy (value = 3)
4. Easy (value = 4)
5. Very easy (value = 5)

The Likert value calculation in this test has the following percentage values:

Tabel 9 Percentage of Likert value

Persentase	Keterangan
0% - 19.99%	Tidak Setuju
20% - 39.99%	Kurang Setuju
40% - 59.99%	Cukup Setuju
60% - 79.99%	Setuju
80% - 100%	Sangat Setuju

To calculate the maximum value for each answer, it is done by multiplying the value by 30 respondents. The maximum score itself can be seen in table 10

Tabel 10 Maximum Score

Jawaban	Opsi	Nilai	Skor (Rank * Jumlah Responden)
Sangat Sulit	1	1	30
Sulit	2	2	60
Cukup Mudah	3	3	90
Mudah	4	4	120
Sangat Mudah	5	5	150

Based on table 10 above, you can find the percentage of each answer with the formula:

$$Y = \frac{TS}{Skor\ Max} x\ 100\% \quad \ldots\ldots\ldots\ldots\ldots (4.1)$$

Information:

Y = Percentage Value

TS = Total Score of Respondents = Σ Value x Respondents

Max Score = Max Value x Number of Respondents = 5 x 30 = 150

The complete answers to be filled in by the respondent are attached in the attachment.

The results of each question are calculated as a whole mean and will be compared with Table 10 to draw an overall conclusion. The overall questionnaire processing will be shown in table 11

Tabel 11 Processing Scale

No Pertanyaan	Nilai Persentase (%)	Keterangan
1	74	Setuju
2	77.33	Setuju
3	78.33	Setuju
4	78.66	Setuju
5	79.33	Setuju
6	75.33	Setuju
7	77.33	Setuju
8	78.66	Setuju
9	84	Sangat Setuju
Rata - rata	**78.14**	**Setuju**

B. Level of Accuracy

Measurement of the level of accuracy is intended to determine how much the potential accuracy of a system is. Where logically if a system has a high level of accuracy, the output of the system is reliable and has valid results. In its measurement, the level of accuracy will be measured by providing experimental results with known outputs to experts who are experienced in their fields to be corrected, until the following data are obtained:

Table 12 Table of Expert Accuracy Level (Rahma Dani Lubis)

NO.	Suhu(°C)	Keasaman (pH)	tds(tds)	Turbidity (ntu)	Kategori	Rule	Nilai Keyakinan (%)	Pakar
1	14	7	1348	220	Air tercemar	54	83,247	✓
2	24	6	208	265	Air boleh digunakan	125	67,876	✓
3	18	11	473	298	Air tercemar	70	91,282	✓
4	22	10	55	109	Air boleh digunakan	144	67,247	✓
5	15	11	1593	95	Air tercemar	73	91,834	✓
6	0	1	670	35	air tercemar	7	84,467	✓
7	27	5	1932	201	Air boleh digunakan	114	63,316	✓
8	3	2	2090	287	Air tercemar	20	95,307	✓
9	4	5	901	52	Air boleh digunakan	28	41,874	✓
10	21	2	739	184	Air tercemar	89	85,268	✓
11	11	11	1944	61	Air tercemar	73	91,384	✓
12	17	13	1654	48	Air tercemar	72	88,786	✓
13	25	12	132	106	Air boleh digunakan	144	67,247	✓
14	1	9	497	267	Air tercemar	49	79,283	✓
15	29	10	560	203	Air tercemar	229	89,456	✓
16	29	7	967	132	Air tercemar	209	74,149	✓
17	19	10	1671	79	Air boleh digunakan	153	49,439	✓
18	18	5	1717	51	Air boleh digunakan	33	42,52	✓

Information:

Multiple Trials: 50

Number of Corrects: 50

Number of Incorrect: 0

Percentage: 100%

Table 13 Table of Expert Accuracy Level (Rahmad Fauzi)

NO.	Suhu(°C)	Keasaman (pH)	tds(tds)	Turbidity (ntu)	Kategori	Rule	Nilai Keyakinan (%)	Pakar
1	14	7	1348	220	Air tercemar	54	83,247	✓
2	24	6	208	265	Air boleh digunakan	125	67,876	✓
3	18	11	473	298	Air tercemar	70	91,282	✓
4	22	10	55	109	Air boleh digunakan	144	67,247	✓
5	15	11	1593	95	Air tercemar	73	91,834	✓
6	0	1	670	35	air tercemar	7	84,467	✓
7	27	5	1932	201	Air boleh digunakan	114	63,316	✓
8	3	2	2090	287	Air tercemar	20	95,307	✓
9	4	5	901	52	Air boleh digunakan	28	41,874	✓
10	21	2	739	184	Air tercemar	89	85,268	✓
11	11	11	1944	61	Air tercemar	73	91,384	✓
12	17	13	1654	48	Air tercemar	72	88,786	✓
13	25	12	132	106	Air boleh digunakan	144	67,247	✓
14	1	9	497	267	Air tercemar	49	79,283	✓

Information:

Multiple Trials: 50

Number of Correct: 48

Number of Wrong: 2

Percentage: 96%

Table 14 Table of Expert Accuracy Level (Wanaila)

	Suhu(°C)	Keasaman (pH)	tds(tds)	Turbidity (ntu)	Kategori	Rule	Nilai Keyakinan (%)	Pakar
1	14	7	1348	220	Air tercemar	54	83,247	✓
2	24	6	208	265	Air boleh digunakan	125	67,876	✓
3	18	11	473	298	Air tercemar	70	91,282	✓
4	22	10	55	109	Air boleh digunakan	144	67,247	✓
5	15	11	1593	95	Air tercemar	73	91,834	✓
6	0	1	670	35	air tercemar	7	84,467	✓
7	27	5	1932	201	Air boleh digunakan	114	63,316	✓
8	3	2	2090	287	Air tercemar	20	95,307	✓
9	4	5	901	52	Air boleh digunakan	28	41,874	✗
10	21	2	739	184	Air tercemar	89	85,268	✓
11	11	11	1944	61	Air tercemar	73	91,384	✓
12	17	13	1654	48	Air tercemar	72	88,786	✓
13	25	12	132	106	Air boleh digunakan	144	67,247	✓
14	1	9	497	267	Air tercemar	49	79,283	✓
15	29	10	560	203	Air tercemar	229	89,456	✓
16	29	7	967	132	Air tercemar	209	74,149	✓
17	19	10	1671	79	Air boleh digunakan	153	49,439	✓
18	18	5	1717	51	Air boleh digunakan	33	42,52	✗
19	18	3	371	155	Air tercemar	4	85,589	✓

Information:

Multiple Trials: 50

Number of Corrects: 47

Number of Wrong: 3

Percentage: 94%

Based on the data set that has been found above, it can be concluded that the average accuracy of this system is as follows:

Average TK = Σ (TK expert1 + TK expert2 + TK expert1) / 3

= (100 + 96 + 94) / 3

= 96,667%

V. CONCLUSIONS AND SUGGESTIONS

A. Conclusion

From the experiments and experiments above, it can be drawn as follows:

1. The results of the Android application to determine water quality using the Fuzzy Inference System method run well with an accuracy of 96,667%

2. Based on the results of alpha testing, the application can run well and as expected with an accuracy value of 100%.

3. Based on the results of beta testing, this application has an average reusability value of 30 respondents with a value of 78.14%.

B. Suggestions

The author's suggestions for this final project to be better developed are as follows:

The development of a form of air quality tester in the future will be added with chemical parameters, namely dissolved oxygen.

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