CHAPTER 4
ANALYSIS AND DESIGN

4.1 Analysis

The design of the internet-based Clean and Dirty Water Sensor uses several parts to analyze a problem. This prototype consists of hardware, software.

Illustration 4.1.1 : Arduino UNO

1. Arduino Uno Board

Arduino uno is a microcontroller board based on ATmega328P, which consists of 6 analog input pins, 14 digital pins, a power jack, a USB connector, and an ICSP (*In Circuit Serial Programming*) header. Programmed based on IDE (*Integrated Development Environment*). Functions to control and process data from input devices and forward them to output devices.

[1]Google "Understanding Arduino Uno" accessed from https://ilearning.me/sample-page 162/arduino/pengertian-arduino-uno/ , on June 15, 2021

Illustration 4.1.2 : LDR Sensor Module

2. LDR Sensor

Light Dependent Resistor or commonly called LDR is a resistor whose resistance value or resistance depends on the intensity of the light received. When the light is bright, the resistance value will decrease and when the light is dark, the resistance value will be high. So it can be said that this LDR functions to deliver electric current when receiving light intensity and inhibits electric current when dark conditions. The LDR used by the author in this study is the LDR Sensor Module.

[2]Google "Pengertian LDR Sensor" accessed from https://teknikelektronika.com/pengertian-ldr light-dependent-resistor-cara-mengukur-ldr/ , on June 15, 2021

Illustration 4.1.3 : TDS Sensor

3. TDS Sensor

Total Dissolved Solid or TDS is a solid dissolved in water in the form of organic ions, compounds, or colloids in water. The higher the TDS value, the cloudier the water, and the lower the TDS value, the clearer the water. This TDS sensor serves as a tool to measure the amount of dissolved substances in water.

[3]Google "Pengertian TDS Sensor" accessed from https://digiwarestore.com/en/sensor other/gravity-analog-tds-sensor-meter-for-arduino-296333.html , on June 15, 2021

Illustration 4.1.4 : LED

4. LED

Light Emitting Diode or often abbreviated as LED is an electronic component that can emit monochromatic light when a forward voltage is applied. The LED has two poles, namely the positive pole (P) and the negative pole (N), which will only emit light when a forward voltage is applied from the anode to the cathode. This LED serves as a warning for the quality of the water that will be produced, Green if the water is clear, Yellow if the water is moderate, Red if the water is cloudy.

[4]Google "Pengertian LED" accessed from https://teknikelektronika.com/pengertian-led-light emitting-diode-cara-kerja/ , on June 15, 2021

Illustration 4.1.5 : Ethernet Shield

5. Ethernet Shield

This module is used to connect Arduino Uno to the Internet. This Ethernet shield is based on the Wiznet W5100 ethernet chip. RJ-45 LAN cable is used to connect Ethernet to the Internet. The way it works is by connecting ethernet to Arduino, then connecting using an RJ-45 cable to the Internet and setting the IP address on the module and PC.

[5]Google “Pengertian Ethernet Shield” accessed from https://www.immersa lab.com/pengertian-ethernet-shield-dan-cara-kerjanya.html, on June 15, 2

4.2 Design

4.2.1 Flowchart System

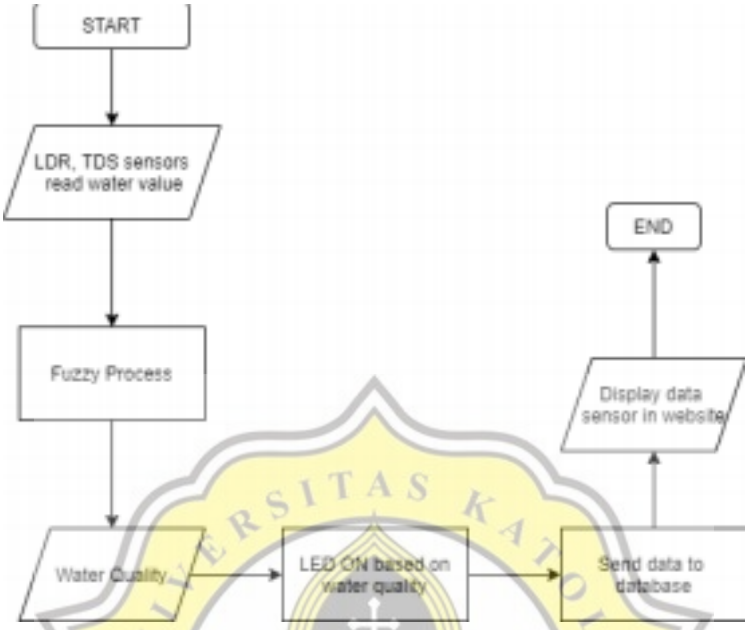

Illustration 4.2 .1 : Flowchart System

The picture above is a flowchart of the clean water and cloudy water sensor system that was made in this study. As input from the system is the level of turbidity using an LDR sensor, and solutes using a TDS sensor. After the data is obtained, the data is processed using fuzzy logic and when the fuzzy logic process is complete it will get the final result in the form of water quality level output.

4.2.2 Flowchart Fuzzy Sugeno

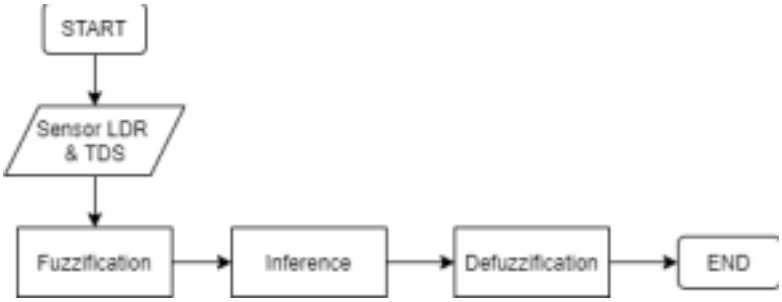

Illustration 4.2.2 : Flowchart Fuzzy Sugeno Process

The fuzzy flowchart above is a stage in the fuzzy logic process. The first stage is the process of forming a fuzzy set or fuzzification of the two sensors, namely LDR and TDS. After the

process is complete, the next step is the formation of fuzzy rules or fuzzy rules, then using the MIN method will find the value of each rule. After the implication process is complete, then defuzzification is carried out using the weighted average method.

Fuzzification

At the initial stage of this fuzzy method is to form a fuzzy set or fuzzification where the process is done by changing the input crisp set (crisp) into a membership function or membership function. To determine the conditions of turbidity and the amount of dissolved substances in the water sample, LDR and TDS sensors are used as measurements.

1. Turbidity level fuzzy variable (LDR) The

turbidity level variable is divided into 3 sets with each value:

Clear = 0 – 50

Cloudy = 50 – 200

Very Cloudy = 200 – ~

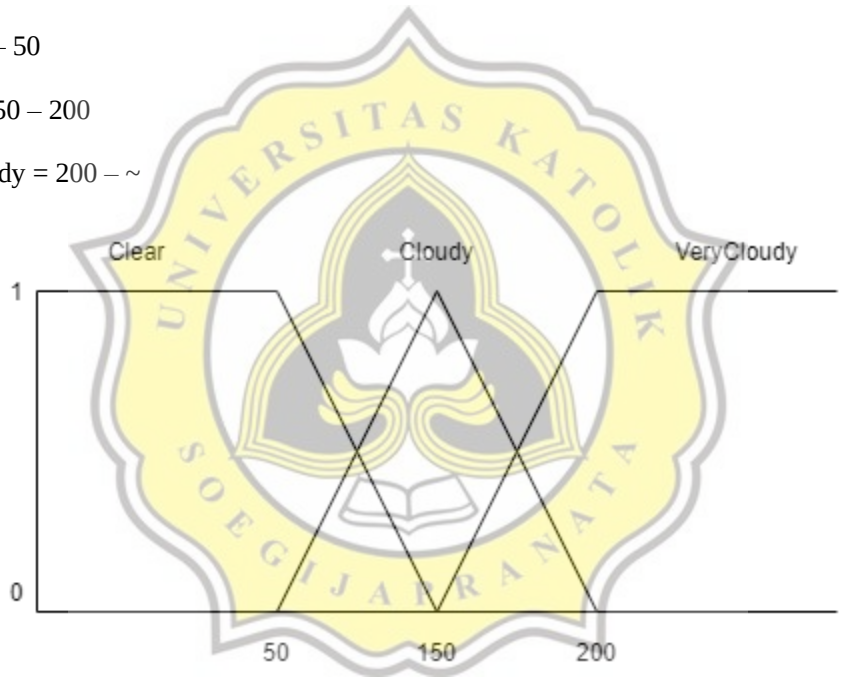

Illustration 4.2.3 : turbidity membership degree graph

Based on In the illustration above, there is a formula for calculating the fuzzy from the turbidity level as follows:

Clear	1 ,	x <= 50
	c - x / c - b ,	b <= x <= c
	150 - x / 150 - 50,	50 <= x <= 150
	150 -x / 100 ,	50 <= x <= 150

0 , x >= 150

Cloudy	x - a / b - a ,	a <= x <= b
	x - 50 / 150 - 50,	50 <= x <=150
	x - 50 / 100 ,	50 <= x <=150
	c - x / c - b ,	b <= x <= c
	200 - x / 200 - 150 ,	150 <= x <= 200
	200 - x / 150 ,	150 <= x <= 200

Very Cloudy	x - a / b - a ,	a <= x <= b
	x - 150 / 200 -150 ,	150 >= x <= 200
	x - 150 / 100 ,	150 >= x <= 200
	1 ,	x >= 200

2. Variable fuzzy amount of TDS

In the variable calculating the amount of TDS there are 3 parameters with a range of values as follows:

a. Few = 0 – 300

b. Medium = 300 – 900

c. Lots = 1000 – ~

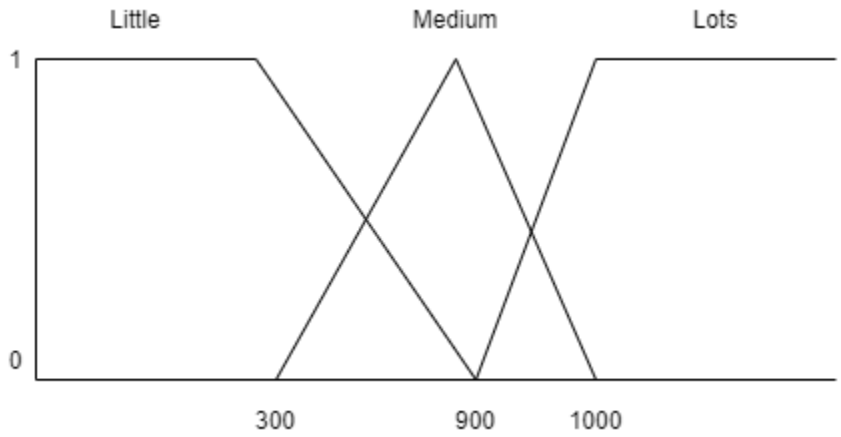

illustration 4.2.4 : TDS membership degree graph

Based on the graph above, there is a formula for calculating the amount of TDS in water as follows:

Little 1 , x <= 300

c - x / c - b , b <= x <= c

900 - x / 900 -300 , 900 <= x <= 300

900 - x / 600 , 900 <= x <= 300

0 , x >= 900

Medium x - a / b - a , a <= x <= b

x - 300 / 900 -300 , 300 <= x <= 900

x - 300 / 600 300 <=x <= 900

c - x / c - b , b <= x <= c

1000 - x / 1000 - 900, 900 <= x <= 1000

1000 - x / 100 , 900 <= x <= 1000

0 , x <= 900

Lots x - a / b - a , a <= x <= b

x - 900 / 1000 - 900, 900 <= x <= 1000

x - 900 / 100, 900 <= x <= 1000

1 , x >= 1000

3. Output Variable Water Quality

In this output variable is divided into 3 quality categories water is feasible, moderate, and not feasible with constant values that have been set by the author as follows:

a. Feasible = 2

b. Medium = 4

c. Not Feasible = 6

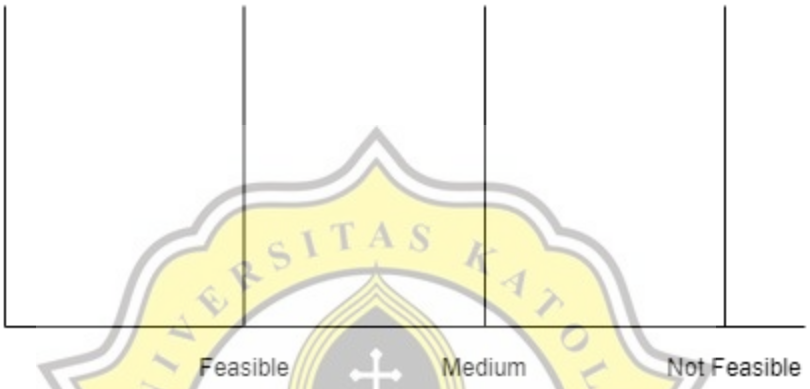

Illustration 4.2.5 : graph of the singleton membership function of water quality

Inference & Fuzzy rule

After going through the fuzzification process, then forming a fuzzy rule, this rule serves to state the relationship between input and output. In this study, the author uses a zero-order Sugeno method of fuzzy inference, where each implication rule is in the form of "if…then" antecedent in the form (AND), and the membership value is in the form (MIN), for example: if AB is Z AND CD is X where AB is and CD is the linguistic variables defined by the variable X and Z.

Table 4.1: Table fuzzy rule

Rule	LDR	TDS	Water Quality
1	Clear	Little	Feasible
2	Clear	Medium	Medium
3	Clear	Lots	Not Feasible
4	Cloudy	Little	Medium
5	Cloudy	Medium	Medium

6	Cloudy	Lots	Not Feasible
7	Very Cloudy	Little	Not Feasible
8	Very Cloudy	Medium	Not Feasible
9	Very Cloudy	Lots	Not Feasible

Defuzzification

Defuzzification process is a process the output of the fuzzy rule predetermined to be value input in this defuzzification process. using the Weighted Average Method, this method is tasked with finding the average with the following rules:

IF (X1 is A1) … (X2 is A2) THEN z=k

where A is a fuzzy set as the reason, … is an operator (AND or OR) and k is a firm constant in conclusion.