

CHAPTER 3

RESEARCH METHODOLOGY

1. Devices and Sensors

The sensors that I will use in this project to retrieve data are the FC-28 soil moisture sensor, DHT11 Temperature sensor, and BH1750 Light Intensity sensor. FC-28 is used to measure the moisture level in soil, this sensor is the main sensor to determine whether plants should be watered or not. Next is DHT11, this sensor will measure the temperature at the Mini Greenhouse, this sensor is the second priority sensor to determine whether plants should be watered or not. The last sensor is BH1750, this sensor will measure the level of light intensity received by plants inside the Mini Greenhouse, so this sensor will be placed in the Mini Greenhouse. For the next one, I will use a Submersible Water Pump DC 5V which functions is to pump water to the plants. All these devices I will mount on an Arduino Mega2560 R3 built-in WiFi with ESP8266.

2. Code Programming

I made the code on the Arduino IDE to collect the required data and the data will be sent to the Arduino Mega2560 R3 built-in WiFi with ESP8266.

3. Algorithm and Data Collecting

In this project, I use the Fuzzy Logic algorithm and for the Defuzzification or Fuzzy Inference System (FIS) process, I use Sugeno FIS to get the required data results.

4. Fuzzification

Fuzzification is the first stage of data processing using fuzzy logic, at this stage the value of crisp will be converted into a membership function so that it can be used for further data processing. In this case, I use 3 inputs, that are soil moisture, temperature, and light intensity.

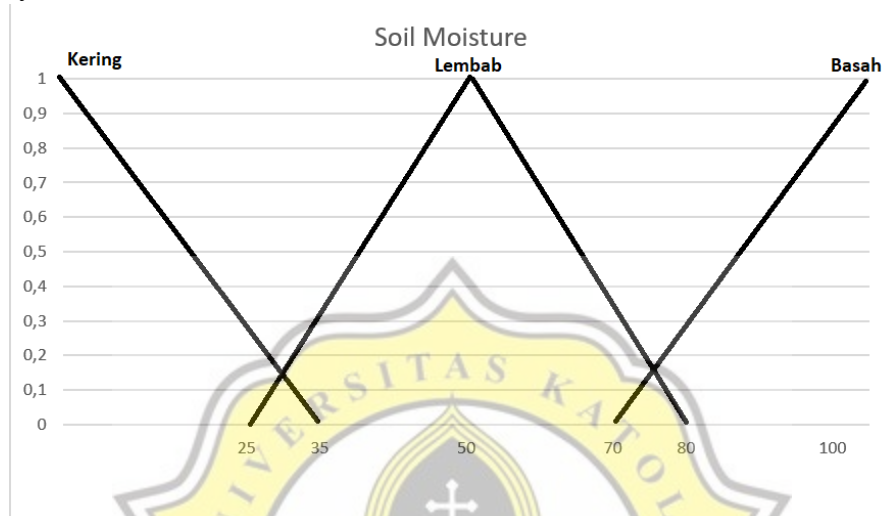


Figure 3.1 Soil Moisture Membership Function

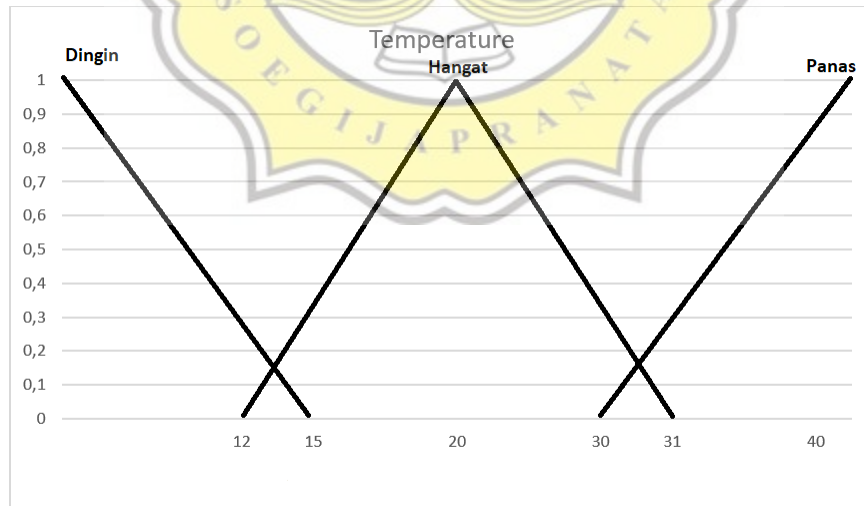


Figure 3.2 Temperature Membership Function

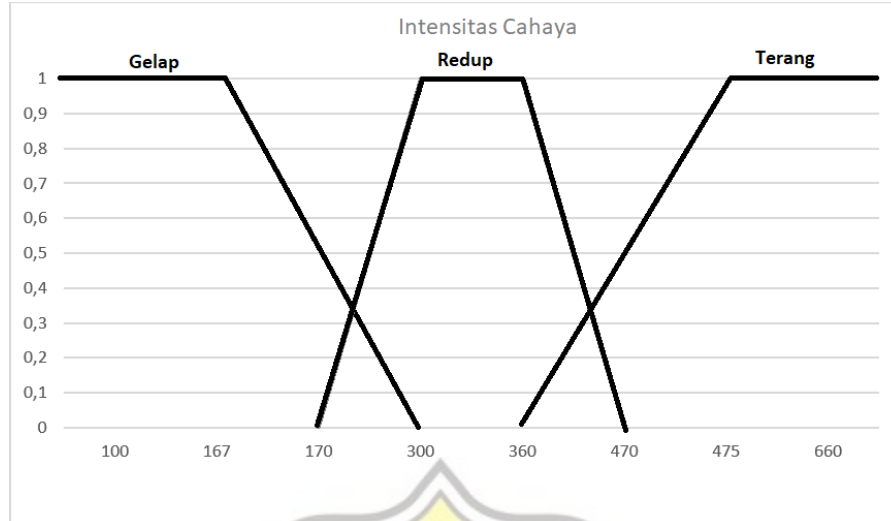
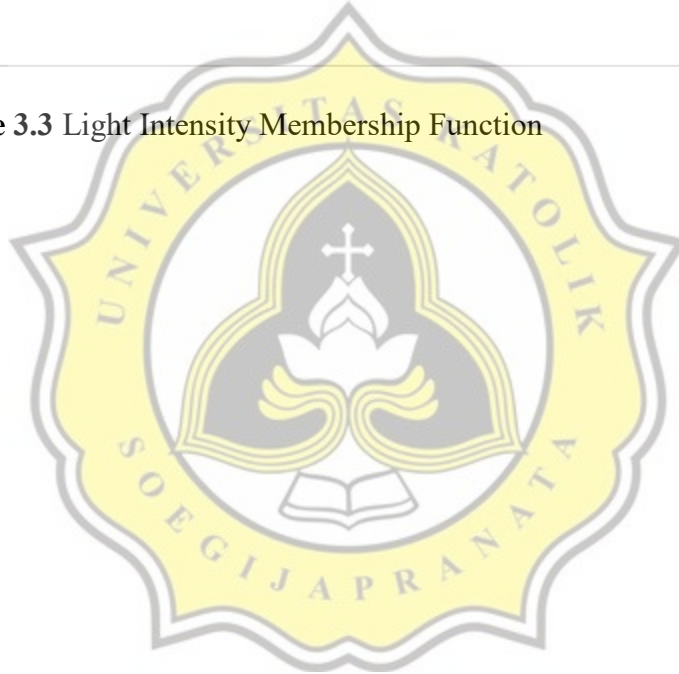


Figure 3.3 Light Intensity Membership Function



5. Fuzzy Rules

In this project, I use 27 fuzzy rules which are based on the rules created by Azmi et al[1] and Nasron and Suroso and Putri [3]. These rules include 3 sensors used, namely soil moisture, temperature, and light intensity. For the soil moisture sensor, the membership function consists of (*kering, lembab, basah*). The temperature sensor also consists of (*dingin, hangat, panas*) and for light intensity, it also consists of a membership function (*gelap, redup, terang*). The rules table as follows:

Rules	Moisture	Temp	Lux	Pump
1	<i>Basah</i>	<i>Dingin</i>	<i>Gelap</i>	OFF
2	<i>Basah</i>	<i>Dingin</i>	<i>Redup</i>	OFF
3	<i>Basah</i>	<i>Dingin</i>	<i>Terang</i>	OFF
4	<i>Basah</i>	<i>Hangat</i>	<i>Gelap</i>	OFF
5	<i>Basah</i>	<i>Hangat</i>	<i>Redup</i>	OFF
6	<i>Basah</i>	<i>Hangat</i>	<i>Terang</i>	OFF
7	<i>Basah</i>	<i>Panas</i>	<i>Gelap</i>	OFF
8	<i>Basah</i>	<i>Panas</i>	<i>Redup</i>	OFF
9	<i>Basah</i>	<i>Panas</i>	<i>Terang</i>	OFF
10	<i>Lembab</i>	<i>Dingin</i>	<i>Gelap</i>	OFF
11	<i>Lembab</i>	<i>Dingin</i>	<i>Redup</i>	OFF
12	<i>Lembab</i>	<i>Dingin</i>	<i>Terang</i>	OFF
13	<i>Lembab</i>	<i>Hangat</i>	<i>Gelap</i>	OFF
14	<i>Lembab</i>	<i>Hangat</i>	<i>Redup</i>	ON
15	<i>Lembab</i>	<i>Hangat</i>	<i>Terang</i>	ON
16	<i>Lembab</i>	<i>Panas</i>	<i>Gelap</i>	OFF
17	<i>Lembab</i>	<i>Panas</i>	<i>Redup</i>	ON
18	<i>Lembab</i>	<i>Panas</i>	<i>Terang</i>	ON
19	<i>Kering</i>	<i>Dingin</i>	<i>Gelap</i>	OFF
20	<i>Kering</i>	<i>Dingin</i>	<i>Redup</i>	ON
21	<i>Kering</i>	<i>Dingin</i>	<i>Terang</i>	ON
22	<i>Kering</i>	<i>Hangat</i>	<i>Gelap</i>	OFF
23	<i>Kering</i>	<i>Hangat</i>	<i>Redup</i>	ON
24	<i>Kering</i>	<i>Hangat</i>	<i>Terang</i>	ON
25	<i>Kering</i>	<i>Panas</i>	<i>Gelap</i>	OFF
26	<i>Kering</i>	<i>Panas</i>	<i>Redup</i>	ON
27	<i>Kering</i>	<i>Panas</i>	<i>Terang</i>	ON

Table 4.1 Fuzzy Rules

6. Defuzzification

Defuzzification is the last stage of data processing using fuzzy logic. this stage can also be called the Fuzzy Inference System (FIS). In this project, I use Sugeno FIS to get the required data results. In this case, I use 1 output (mini pump)

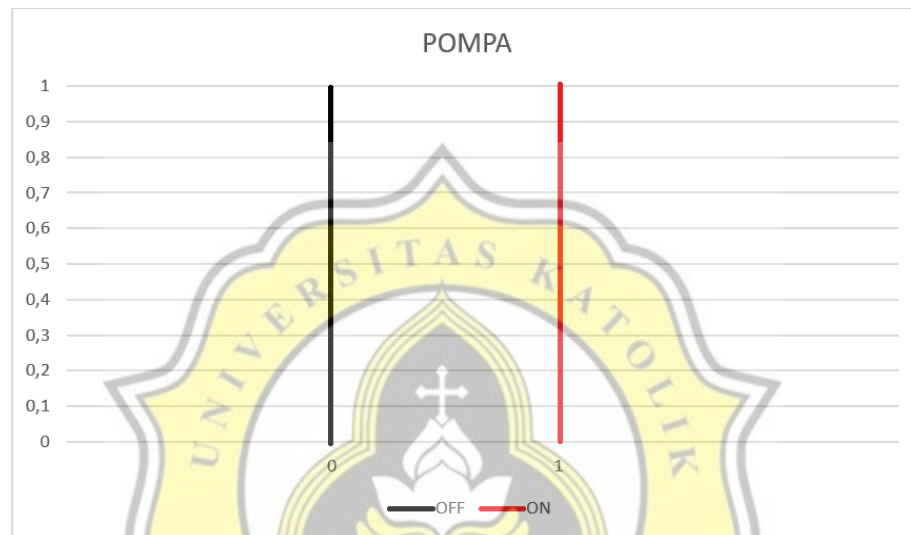


Figure 3.4 Mini Water Pump Singleton Membership Function

7. Blynk App for notification

After the plants are watered, the user will get a notification from the Blynk application notifying them that the plants have been watered, but if the plants do not need to be watered, Blynk will not notify the user. Users will only get notifications when the plants are watered.