CHAPTER 4
ANALYSIS AND DESIGN

4.1. Analysis

The purpose of this project is to develop a device that will be able to water the plants from which the data has been taken from moisture sensor, temperature sensor, and light sensor automatically using Fuzzy Logic algorithm and can provide notification to the user when the plants are watered. The components of sensors, modules, microcontrollers, and other electrical devices in this research include :

1. Arduino Mega2560 R3 built-in WiFi with ESP8266.
2. FC-28 soil moisture sensor
3. DHT11 Temperature sensor
4. BH1750 Light Intensity sensor
5. Submersible Water Pump DC 5V
6. Relay Module 4 Channel DC 5V
7. 9V 0,6A Power Adaptor
8. Custom Home Made Mini Greenhouse
9. Bread Board

4.2. Design

The design of this device consists of FC-28 soil moisture sensor, DHT11 Temperature sensor, BH1750 Light Intensity sensor, Submersible Water Pump DC 5V, Relay Module 4 Channel mounted on Arduino Mega2560 R3 built-in WiFi with ESP8266 and powered by 9V 0.6A Power Adapter. This device will be placed in a mini greenhouse along with the leek plants that have been planted. The roof of this mini greenhouse can be detached and re-reattached to make Arduino installation easier, dimensions of this mini greenhouse are as follows.

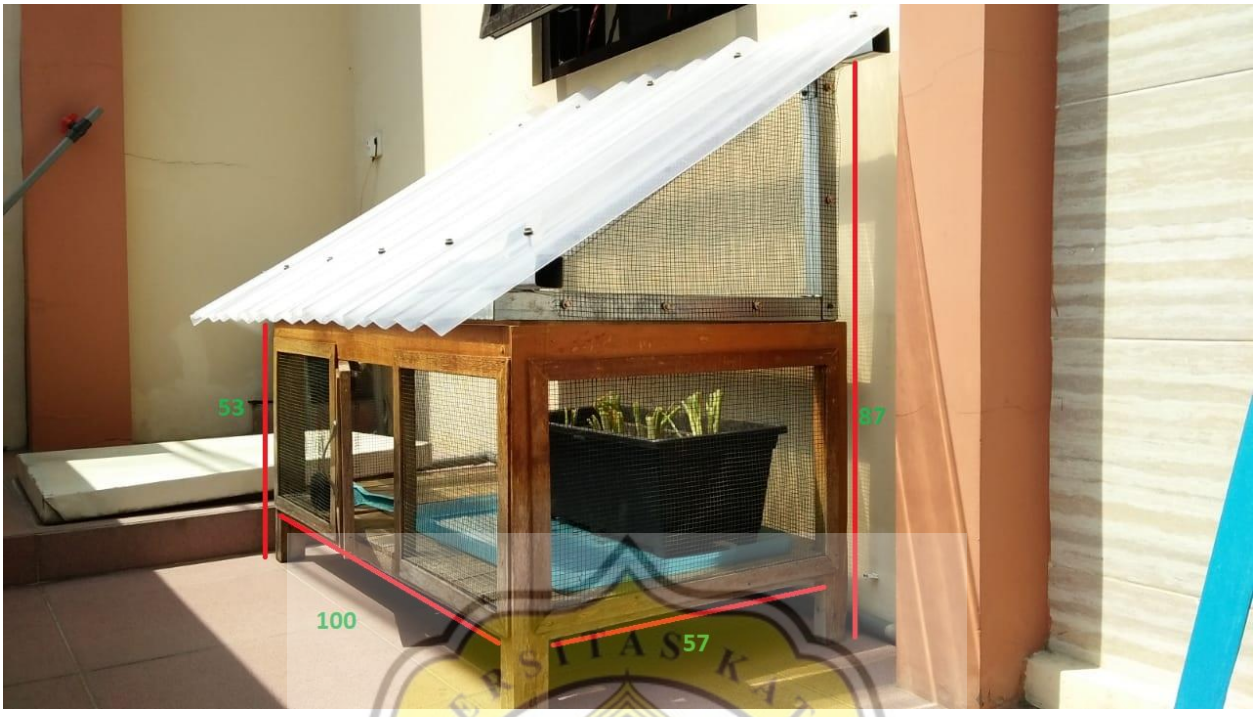


Figure 4.1 Greenhouse Size in cm

Figure 4.2 Detached Greenhouse

Figure 4.3 Inside Greenhouse

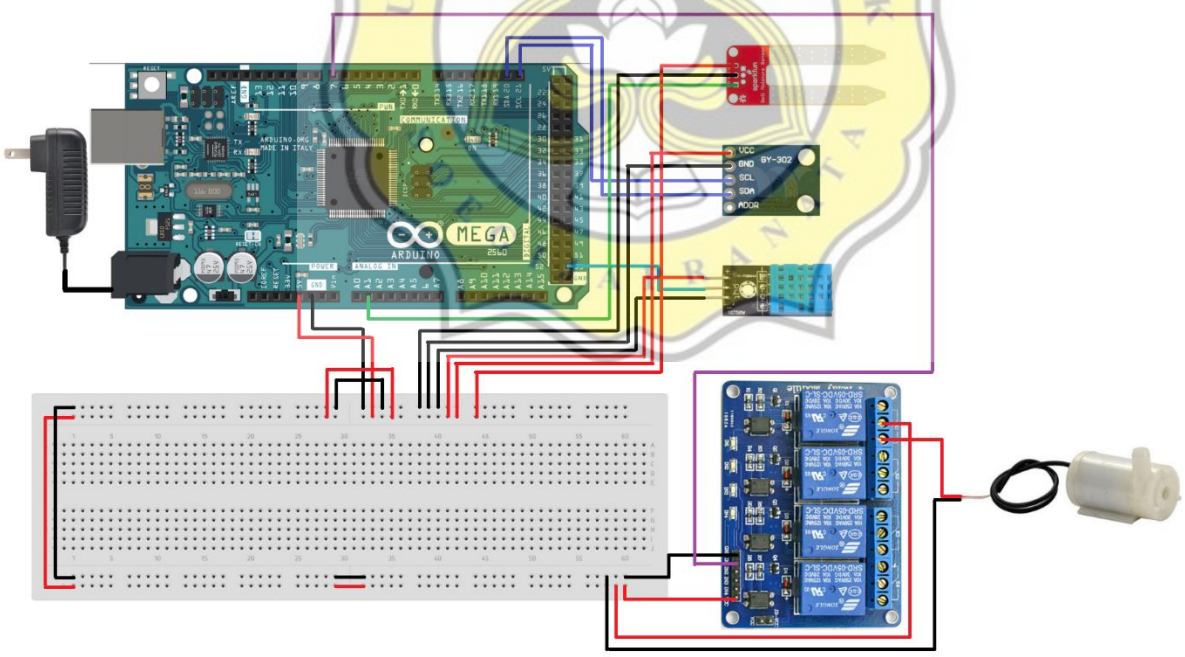
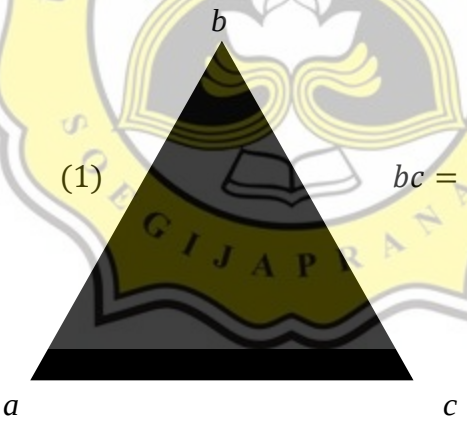


Figure 4.4 Arduino Circuit In Detail

Sensor data retrieval will begin after Arduino is activated. Arduino will take and read data from the three sensors (Moisture, Temperature, Light intensity), after the sensor data is obtained it will start the fuzzification process. In the process of fuzzification, the data that has been obtained will be entered into the Fuzzy Set, after the Fuzzy Set is obtained the data will then be entered into the Fuzzy Membership, the Fuzzy membership will consist of Moisture, Temperature, Light intensity, and Pumps. After that, the data will be entered into Fuzzy Rules for analysis of what rules are included in the data. After the data is processed in Fuzzy Rules, the defuzzification process will begin, a calculation will occur in the defuzzification process after the output data results are obtained, the pump will run according to the code that has been set.

4.3. Function

The first step needed in the fuzzy logic process is fuzzification. In this function (1), *ab* is the Fuzzy Membership we want to find. Similarly, if we want to find (2), *bc*.



$$ab = \frac{x - a}{b - a} \quad (1) \qquad bc = \frac{c - x}{c - b} \quad (2)$$

Figure 4.5 Illustration For Formula

There is also a formula for calculating Defuzzification (FIS), in this project the FIS I use is Sugeno and the final calculation method I use is the Weight Average formula. In this function (3), *y* is the value of your fuzzy membership, and (3), x is the value of your fuzzification output

$$\text{Weight Average} = \frac{y(1) * x(1) + y(2) * x(2) + y(3) * x(3)}{y(1) + y(2) + y(3)} \quad (3)$$