

## **CHAPTER 4**

### **ANALYSIS AND DESIGN**

#### **4.1 Analysis**

This project is intended to make a device that can sorting tomatoes based on its color, classified into three levels of ripeness, there are ripe tomato, half-ripe tomato, and unripe tomato. This device can sorting tomatoes quickly and accurately. The components needed in this research include:

1. Arduino UNO
2. ESP8266
3. TCS3200
4. Mini Breadboard
5. Motor Servo
6. Step Down
7. Jumper Cable
8. LED.

In this project, the way to classify the tomatoes is to identify the tomatoes' RGB value. TCS3200 Sensor is a sensor that can read RGB value, so it's compatible to identify the color of the tomatoes. This project is also measure the color rate of tomato.

Arduino UNO is used for operating the device. Because using Arduino UNO, so the programming language used for this project is Arduino. Besides that, this project is also use PHP programming language for the website to display the data of the classifying results and MySQL for the database.

#### **4.2 Desain**

##### **4.2.1 Design Of Sorter Device**

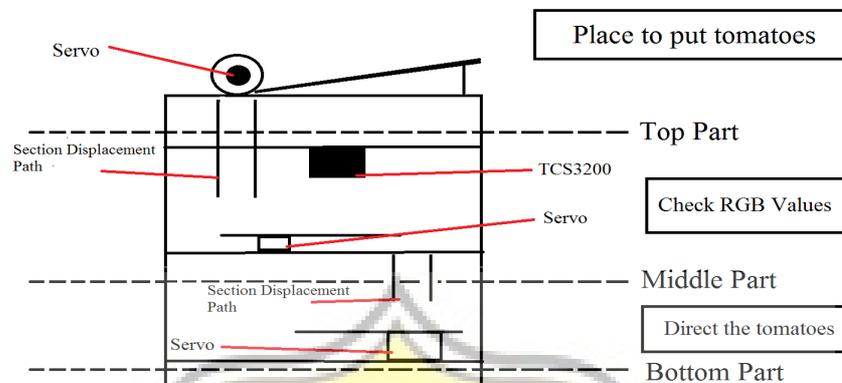


Illustration 4.1: Design Of Sorter Device

The design of this device consists of three parts, there are top part, middle part, and bottom part. The top part is functioned as the place to put the tomatoes and there is a servo to move the tomatoes. The middle part is functioned to checking place of the tomatoes' RGB value and there is a TCS3200 sensor to read the RGB values and a servo to move the tomatoes after values checking. The bottom part there is a servo to move the tomatoes to separate it based on its color after the checking.

ESP8266 is a WiFi module that can be used to to send the data to database through TCP/IP. The RGB data, classified tomatoes result, and color value will be sent to localhost and stored in database. ESP8266 is placed at the middle part with Arduino, step down and servo.

“Kendala yang mungkin muncul dari penggunaan metode ini salah satunya adalah pencahayaan, perbedaan intensitas pencahayaan ruangan akan mempengaruhi akurasi dari metode ini, dan juga pengambilan sample pada proses pengumpulan data akan sangat mempengaruhi kualifikasi kelas yang nantinya akan berdampak pada pengambilan kesimpulan.”.

(Noviyanto, 2009: 12).

Because of that Illumination factor around can affect the tomatoes' RGB value, If the condition is too bright, the RGB value will be too high.

To produce RGB value accurately, the side part of of the separating device is sealed so the light cannot affect the RGB value.

“Dari hasil pengujian jarak pembacaan sensor warna tcs 230 didapatkan jarak 2 cm merupakan jarak optimal pembacaan sensor warna dengan objek benda”.

(Hermawati, 2014: 13).

Therefore the ideal range of TCS3200 sensor to read RGB value is 2 cm, so the range between TCS3200 sensor to the base side is 6 cm with the average diameter of the tomatoes is about 4 cm so the value of the RGB color will be obtained accurately.

#### 4.2.2 Sensor Scheme

There is a series of sensors and Arduino used in this project:

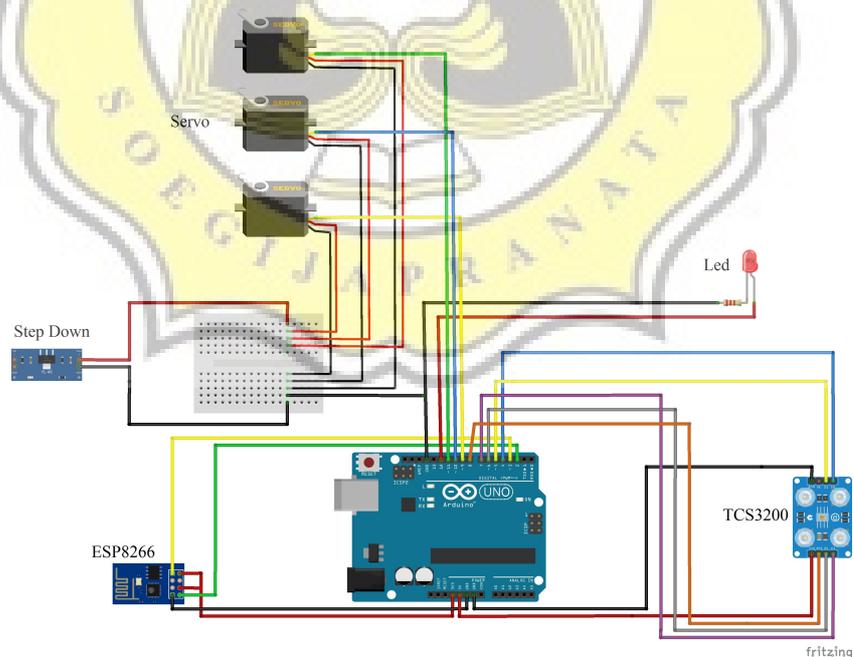


Illustration 4.2: Arduino and Sensor Scheme

From the schema above, this project use TCS3200, servo, ESP8266, step down, mini breadboard and Arduino UNO. TCS3200 is

functioned for read the color of the tomato, the result of the reading is rgb value. Servo is functioned to control the movement of the tomato. ESP8266 module is use for send the data to mysql. All of the sensors is connected with uno, therefore the device needs more power from adaptor. This project uses an adaptor with 12v output, so the adaptor needs to connected with step down to decrease the voltage into 5v.

#### 4.2.3 Data Collection

The tomatoes that are used for data training have circumference 11-12 cm or have average 4 cm of diameter. Gaining data as the base value of ripe tomato, half-ripe tomato, and unripe tomato is done manually first. The tomatoes are classified to three types, ripe tomato (red), half-ripe tomato (orange), and unripe tomato (green). The tomatoes that have been separated manually then put into the device and being read by TCS3200. The RGB value TCS3200 will be used for data training in tomatoes classifying.

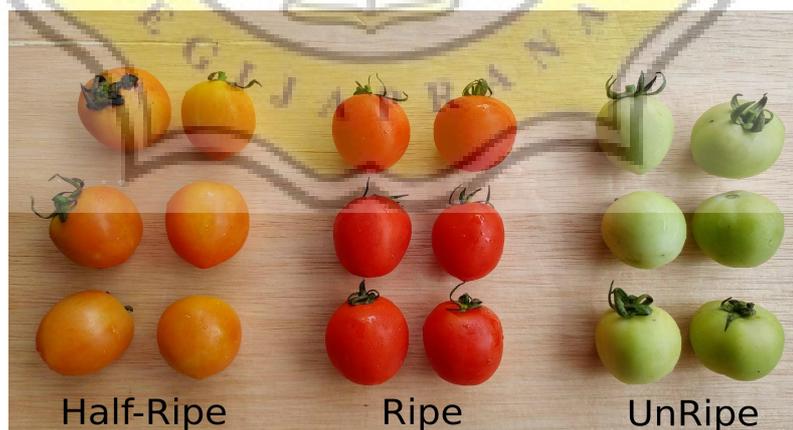


Illustration 4.3: Sample Tomatoes.

#### 4.2.4 Calculate The Color Amount

The next step is to determine the color amount of the tomatoes. Formula to calculate the color amount of the tomatoes is to divide Red, Green and Blue value with the total number of the addition of the three color and multiplied by 100 to get the percentage.

$$\text{Red} = \frac{R}{R+G+B} \times 100\%$$

$$\text{Green} = \frac{G}{R+G+B} \times 100\%$$

$$\text{Blue} = \frac{B}{R+G+B} \times 100\%$$

#### 4.2.5 Classification Of Tomatoes

This project classifies the tomato using two methods, there are RGB value and grayscale value. Those two methods will be tested the accuracy level.

RGB is a color model that are consist of three color channels, there are red, green and blue. Those three channels will be use as an reference for tomato classifying. Here is the flowchart process of the RGB method:

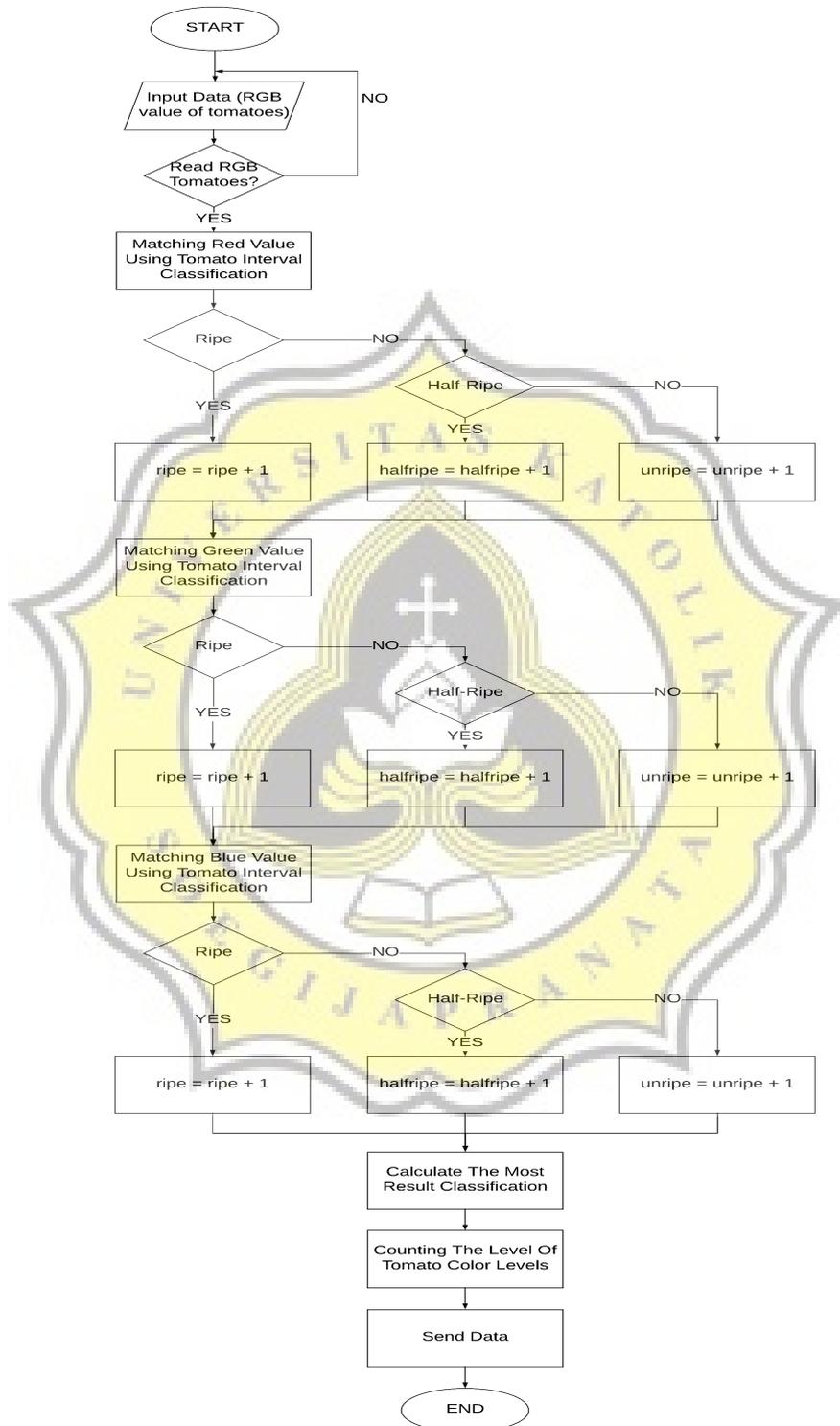
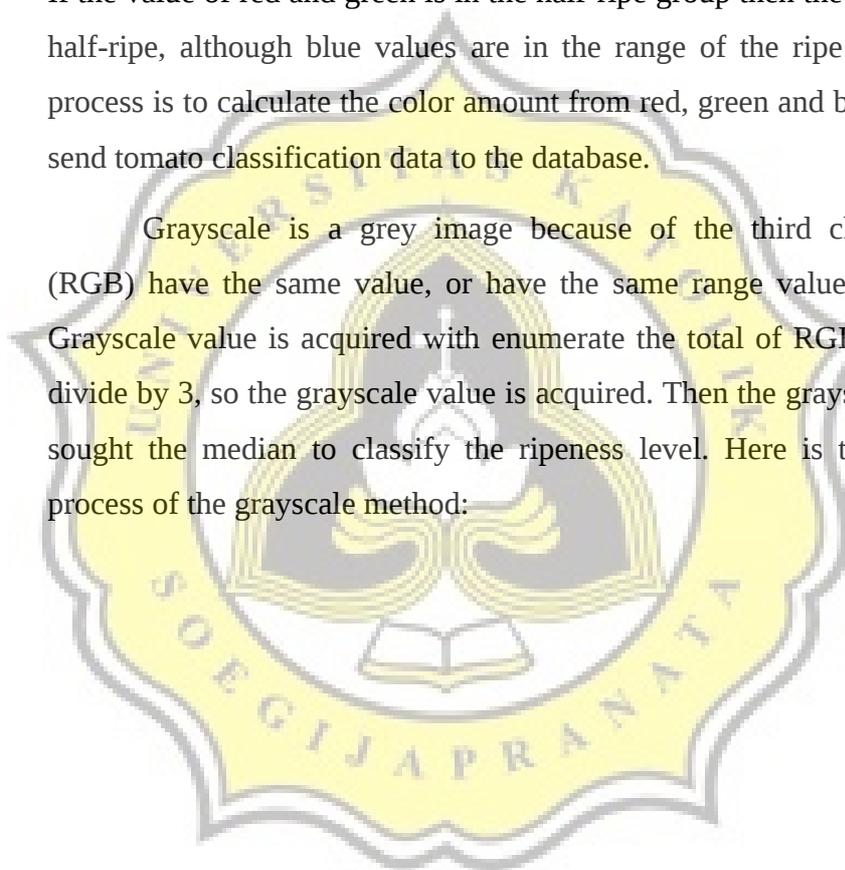


Illustration 4.4: RGB Method Flowchart

The flowchart above is a tomatoes grouping process that uses the

RGB method. The RGB value of the TCS3200 reading will be classified as a condition of ripeness. The tomatoes sorting starts with the tomatoes are inserted into the sorting device. Determine the type of tomato based on the number of conclusions between each RGB. If the value is red, green and blue are in the range of the ripe group, then tomatoes are included as ripe. If the value of red and green is in the half-ripe group then the tomatoes are half-ripe, although blue values are in the range of the ripe group. Next process is to calculate the color amount from red, green and blue, and then send tomato classification data to the database.

Grayscale is a grey image because of the third channel value (RGB) have the same value, or have the same range value of 0 – 255. Grayscale value is acquired with enumerate the total of RGB value, then divide by 3, so the grayscale value is acquired. Then the grayscale value is sought the median to classify the ripeness level. Here is the flowchart process of the grayscale method:



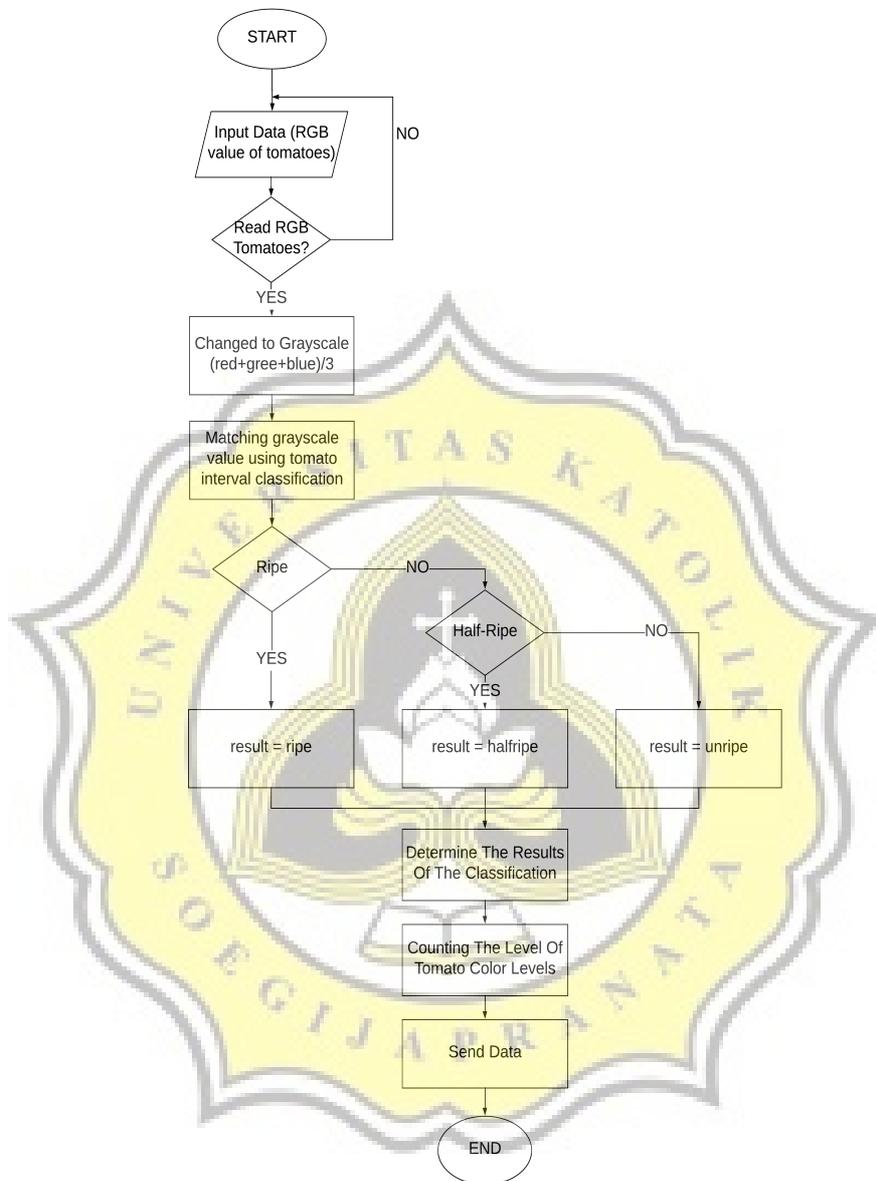


Illustration 4.5: Grayscale Method Flowchart

From the flowchart above explaining how the sorting system of the tomatoes works by using grayscale. The tomatoes sorting starts with the tomatoes are inserted into the sorting device. TCS3200 sensor will acquire the RGB values of the tomatoes. The next process is to change the RGB value to a grayscale value. The grayscale value is obtained by enumerate the RGB values and divided by 3. Tomato ripeness classifying process

determination is based on tomato classifying interval value, If the grayscale value is at ripe interval then tomato is classified as ripe tomatoes. Likewise with half-ripe and unripe tomatoes. Next process is to calculate the color amount from red, green and blue, so the data from the classification of tomatoes will be sent to the database. After the data are put in the database, the next process is to separate the tomatoes to the places that have been separated based on its color.

