Design of Automatic Chili and Tomato Sprinklers Based on Arduino Mega 2560

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Abstract. Farmers generally do not know the amount of water needed by plants. Sometimes they also do not have enough time to water the plants regularly. Merauke Regency has a very strict climate between the rainy season and the dry season. During a prolonged summer can cause plants to experience drought due to lack of water. So, it is necessary to design an automatic plant sprinkler based on soil moisture around the plant. This study designed an automatic chili and tomato sprinkler based on Arduino Mega 2560 in Wasur II Village. The microcontroller used is Arduino mega 2560, soil moisture sensor YL-69, relay, water pump and sensor probe. 3 pairs of 20 cm soil moisture sensors will be connected in series, then plugged into the ground 15 cm deep. As a result, the tool performs watering (relay on) when the soil moisture in chili plants is below 75% and on tomato plants is below 70%. Furthermore, when the soil moisture in chili plants reaches 75.86%, the soil resistance value obtained is 34.58 ohms. Then when the soil moisture in tomato plants reaches 70.19%, the soil resistance value obtained is 42.70 ohms.

Keyword: *Arduino, Sensors, Soil Moisture, Soil Resistance*

1 Introduction

Watering plants that have been done so far is still manual. According to Z.K. Erricson et al that sometimes humans do not have enough time to water plants and do not know how much water the plants need [1]. Water needs for chili and tomato plants must be fulfilled, otherwise it will have a fatal impact on both plants.

The characteristics of meteorological elements, especially rainfall over the territory of Indonesia, are strongly influenced by monsoon climatic conditions, namely the difference between the wet season (rain) and the dry season (dry) which is clear [2]. Merauke Regency has a very strict climate between the rainy and dry seasons. According to (Oldeman 1975), Merauke Regency is in a zone (Agroclimate Zone C) which has a wet period of 5–6 months. Merauke plain has a rather special climatic characteristic in which the rainfall that occurs is influenced by the monsoons, both the north western monsoons (wet monsoons) and the east-east monsoons (dry monsoons) and is also influenced by the topography and elevation of the local area [3].

Based on these conditions, the researchers designed an automatic plant sprinkler for chili and tomato plants based on Arduino Mega 2560 in the Wasur II area. This tool will detect the required soil moisture so that the tool will water the plants and stop automatically when the soil moisture has met the specified moisture limit.

2 Literature Review

Chili is a spice that is often needed by the people of Indonesia. Chili is also a strategic commodity because of its volatile price, thus becoming one of the main determinants of the dynamics of national inflation [4]. Chili can be planted in the highlands, medium and low [5]. Good soil for planting chili is soil that is rich in humus and loose [6]. According to Suhendri et al, the soil moisture needed by chili plants ranges from 60-80% [7, 8]. Meanwhile, tomato plants are generally grown in the highlands, but can also be grown in the middle and lowlands [9]. Tomato plants also require soil moisture reaching 80% [10].

Furthermore, it must first be converted into digital data to read the Analog voltage that enters the Arduino Analog pin. Arduino Analog pins can accept values up to 10 bits, so they can convert Analog data into 1024 states. This means that a value of 0 represents a voltage of 0 volts and a value of 1023 represents a voltage of 5 volts. Data previously converted into digital data is called the ADC (Analog to Digital Conversion) process. If the value of 5 volts is converted to 10 bits digital data, then :

$$\frac{5 \text{ volt}}{1023} = 0,004887585 \text{ volt} \quad (1)$$

This means that every 1 decimal number represents a voltage of 0.004887585 volts [11]. So to find the value of the Analog voltage can be formulated :

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$$\text{Analog Voltage} = \text{ADC Sensor} \times \frac{5 \text{ volt}}{1023} \quad (2)$$

Information :

5 volts = power supply voltage

1023 = maximum ADC value

3 Materials and Methods

Fig. 1. Design of probe sensor

Next, the sensor probe that has been completed will be connected to the Arduino control circuit and relay as shown in Figure 2.

Fig. 2. Arduino Circuit

Finally, Figure 3 shows the circuit schematic of the entire device.

Fig. 3. Complete Circuit

4 Results and Discussion

Measurements are made by taking data every 1000 milliseconds. The sample of data taken is 50 data. Then the time record of each sensor has a difference because Arduino receives data from the sensor in turn. Figure 4 (a) shows, from 13:16:47.5 to 13:19:20.6 the soil

The first tool designed is the sensor probe. This sensor probe uses a 20-cm long copper pipe. Furthermore, the distance between the legs of the probe is 2 cm, and an insulator is installed to support the two feet above the ground. 3 pairs of sensor probes will be connected in series and will be planted 15 cm deep. The distance between the sensor probes is 1.5 meters. Then the distance of the first sensor probe with the YL-69 sensor is 2 meters. For more details, see figure 1.

moisture in chili increased by 75.86% and the relay turned off. Then at 13:19:24.6 the soil moisture dropped to 67.16% and the relay turned on. Then it rose again at 13:19:32.7 by 76.34% and the relay turned off again. While in figure 4 (b) at 13:16:49.5 to 13:17:01.6 the soil moisture in tomatoes is still 0%. Then it rose at 13:17:05.6 to 13:19:14.6 to 70.19% and the relay status was off. Furthermore, the humidity dropped at 13:19:22.6 to 56.99% and the relay status changed to on.

Then the soil moisture rose again at 13:19:34.7 which was 70.48% and the relay went back off. The highest soil moisture is 73.12% at 13:20:07.0. The value of soil moisture in chili and tomatoes can be seen in Figure 4.

(b)

Fig. 4. Soil moisture (a) chili (b) tomato

Next, to find the converted Analog voltage value. Take the value in the first second measurement then :

$$\begin{aligned} \text{Analog Voltage} &= \text{value of ADC sensor} \times \frac{5 \text{ volt}}{1023} \\ &= 1023 \times \frac{5}{1023} \\ &= 5 \text{ volt} \end{aligned}$$

The Analog stress value for soil moisture in chili and tomatoes can be seen in Figure 5.

(a)

(b)

Fig. 5. Graph of Soil Moisture Against Analog Voltage (a) chili (b) tomato

Furthermore, to determine the value of soil resistance, it is calculated using an Analog voltage (V) according to the level of humidity and current (I) based on the sensor specifications, which is 0.035 A. So the value of soil resistance by taking the value in the first second measurement is :

$$\begin{aligned} R &= \frac{V}{I} \\ &= \frac{5}{0.035} \\ &= 142,86 \text{ Ohm} \end{aligned}$$

The value of soil resistance to soil moisture in chili and tomatoes can be seen in Figure 6.

(a)

(b)

Fig. 6. Graph of Soil Resistance Against Soil Moisture (a) chili (b) tomato

Figure 7 shows the Analog voltage value relative to the soil resistance value for chili and tomato.

(a)

(b)

Fig. 7. Graph of Analog Voltage Against Soil Resistance (a) chili (b) tomato

Figure 7 (a) and (b) above shows when the highest analog voltage value is 5 volts, the ground resistance value is 142.86 ohms. Furthermore, the lowest analog voltage value in chili is 0.784 volts and the value of ground resistance is 22.40 ohms. While the lowest analog voltage value in tomatoes is 1.374 volts and the value of ground resistance is 38.50 ohms.

5 Conclusion

Plant sprinklers can work well. Status relay off when the soil moisture value in chili reaches 75% and in tomatoes reaches 70%. Then the relay returns on when the soil moisture value is less than that value. When the soil moisture value in chili reaches 75.86%, the Analog voltage value obtained is 1.210 volts and the soil resistance value is 34.58 ohms. Whereas in tomatoes when the soil moisture value reaches 70.19%, the Analog voltage value obtained is 1.494 volts and the soil resistance value is 42.70 ohms.

References

1. Z. K. Erricson, A. Elia Kendek, and M. Dringhuzen J., "Rancang Bangun Penyiram Tanaman Berbasis Arduino Uno Menggunakan Sensor Kelembaban YL-39 Dan YL-69," *J. Tek. Elektro dan Komput.*, vol. **7**, no. 3, (2018).
2. D. Susilokarti *et al.*, "IDENTIFIKASI PERUBAHAN IKLIM BERDASARKAN DATA CURAH HUJAN DI WILAYAH SELATAN JATILUHUR KABUPATEN SUBANG, JAWA BARAT," vol. **35**, no. 1, pp. 98–105, (2015).
3. W. Christian Wely, D. UrParenden, and S. Peter, "ANALISIS UNJUK KERJA KINCIR ANGIN MODEL P-200W DAN KINCIR ANGIN MODEL JPS-200 DI MERAUKE," vol. **1**, no. 1, pp. 21–24, (2018).
4. R. A. Nugrahapsari and I. W. Arsanti, "ANALISIS VOLATILITAS HARGA CABAI KERITING DI INDONESIA DENGAN PENDEKATAN ARCH GARCH Analizing Curly Chili Price Volatility in Indonesia Using the ARCH GARCH Approach," vol. **36**, no. 1, pp. 25–37, (2019).
5. R. Rudi, "PERTUMBUHAN DAN HASIL TUJUH GENOTIPE CABAI RAWIT HIBRIDA SPESIES *Capsicum annum* L. DI DATARAN RENDAH," Bengkulu University, (2017).
6. M. Rizky and A. Saputra, "RANCANG BANGUN SISTEM PENYIRAM PADA TANAMAN CABAI BERBASIS ATMEGA16," (2018).
7. S. Suhendri, B. Irawan, and T. Rismawan, "SISTEM PENGONTROLAN KELEMBABAN TANAH PADA MEDIA TANAM CABAI RAWIT MENGGUNAKAN MIKROKONTROLER ATMEGA16 DENGAN METODE PD (PROPORTIONAL & DERIVATIVE)," *J. Coding, Sist. Komput. Untan*, vol. **03**, no. 3, pp. 45–56, (2015).
8. A. Ferdianto, F. Teknik, and U. B. Luhur, "Pengendalian kelembaban tanah pada tanaman cabai berbasis fuzzy logic," vol. **1**, no. April, pp. 86–91, (2018).
9. S. M. Dewi and M. Syukur, "Interaksi Genotipe x Lingkungan Hasil dan Komponen Hasil 14 Genotipe Tomat di Empat Lingkungan Dataran Rendah Genotype x Environment Interaction of Yield and Yield Components of 14 Tomato Genotypes in Four Lowland Environments," vol. **43**, no. 1, pp. 59–65, (2015).
10. M. Rizky, "PEMODELAN SMART PROFILE GREENHOUSE BERBASIS NEURAL NETWORK PEMODELAN SMART PROFILE GREENHOUSE," (2017).
11. D. P. W. Hardi and H. Afandi, "Prototipe Pengukur Kelembaban Tanah Dan Intensitas Cahaya Berbasis Arduino Uno," *Semin. Nas. Edusainstek*, pp. 115–119, (2018).