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Implementation of Automation System for Humidity Monitoring and Irrigation System

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Abstract. Smart farming, Precision Agriculture or Smart-Agriculture is a modern agricultural technique that has been widely practiced in developed countries to meet the challenges of increasing demand for food. Smart farming involves a variety of communication and information technologies to improve the quality and quantity of agricultural commodity crops. One application of technology in smart farming is plant cultivation automation system. The automation system for irrigation system will cause the efficiency of energy, time, and amount of water used. This paper discusses the implementation of the soil moisture sensor YL-69 to automate the sprinkler system. Monitoring of sensor measurement is displayed on LCD screen and displayed on line and real time on the website. The test results show if the sensor shows soil moisture value below 15%, the relay will turn on the water pump and turn it off when the moisture value reach 45% with the respond time about 1, 29 second. On line test results show the displayed value in LCD equals to the value displayed in the website.

1. Introduction

Currently, the world population has reached more than 7 billion and is expected to reach 9.3 billion in 2050. The population explosion will affect mainly on increasing world food demand. In 2050 the researchers predict demand for food will rise to 60% [1]. Demand for food, directly affect the necessity of increasing agricultural output. Agriculture is the main food producer and the driving force of a country's economy. Increasing demand in the field of food will directly increase the prestige of the agricultural industry. The agricultural sector must move from conventional farming to modern agriculture. In modern agriculture, farmers have full control and are able to adapt technologies and information to control several important factors in their farming systems. Modern agriculture aims not only to increase the financial benefits of farmers and reduce production risk [2] but also to meet the food needs of the world community in the future. Modern agriculture aims to reduce the cost of production with the production management efficiency and improve the quality and quantity of the crop[3].

Smart Farming (SF) has grown rapidly in some developed countries, such as USA, Germany and Canada. The 3 main components in Smart Farming are Technology, Communication and Management. SF involves various disciplines, including agricultural engineering, electronics engineering, informatics engineering, environmental engineering, Biology, Chemistry and management. In the field of engineering, SF Technology includes [4]:

- Sensor Technology
- Software applications
- Communication systems such as Cellular technology and the internet

- GPS and GIS Technology
- Software and hardware systems
- Data analysis and storage

SF will produce agriculture that provides more benefits and reduces agricultural risks such as pests, excessive radiation, environmental pollution, disturbance of animals around and so on [2].

One of the technologies that could be adapted for agriculture is watering system. Crop irrigation is the largest user of water spending about 70% of global freshwater withdrawals. Increasing food, feed, fibre and bio-fuel demand by continued population growth is handled by escalating irrigation spots, especially in developed countries. Farmers and field level staff are at the core of any process of transformation and need to be encouraged and guided through suitable technologies and practices towards water saving [5].

Watering plants can be arranged automatically by utilizing the development of microcontroller technology. Microcontroller is a functional computer system in a chip. It contains a processor core, memory (small amount of RAM, program memory, or both), and input output equipment. To assist the conditioning of soil moisture, an automated system is needed to sprinkler the plants and to observe the soil moisture, thus cultivation can be easier than conventional farming.

The automated system proposed together with web and mobile applications turn a low effectiveness system into a high accuracy one which can be controlled and directly contribute to the productivity of the plant, besides improving the use of hydro resources and decreasing the environmental impact which is caused by an unsteadily controlled sprinkler management [6]. Through developing and designing of hardware and software, experiments in the automation of irrigation system prove that it has succeed in implementing auto water-saving irrigation, which reduces water spending and power system consumption [7].

To encourage the automation in the agriculture, it is a trend to apply the IoT technology. The environmental monitoring system based on the IoT (internet of things) can gather the fast, accurate and constant measurement requirements in the precision agriculture [8]. Sensor technology is mostly responsible for the information gathering of IoT. It is the foundation service and application to achieve the perception of real-world. It is the sensor that connections the changes in the real world into quantitative data and sends these data to specified site through certain techniques [9].

In this paper, we discuss the implementation of YL-69 sensor to measure the soil humidity level and display the results on the LCD and in the website. The value of the measurement will function as the indicator to automate the irrigation system for watering the plant.

2. Methods

The automation system utilizes the YL-69 sensor technology as data input to monitor the soil humidity. The ESP8266 module will function as data processing and Wi-Fi network server. The humidity data than transmitted through Wi-Fi network and send to the web server, so the value of soil humidity could be displayed at web browser which can be access in the internet-connected computer.
ESP8266-module functions as microcontroller and transmitted the Wi-Fi network. Soil humidity sensor will send the voltage input to the microcontroller which will be changed various depend to the measured value. LCD first connected to I2C-module than connected to ESP8266-module, so it only has 2 control paths that are SDA (Serial Data) and SCL (Serial Clock). A series of relay modules and water pump are used to turn on and turn off the water pump based on how the relay module mechanism works.

The next step is software designing. The designing of software is started with writing the algorithm programming to controlling the microcontroller as the main unit of the automation system. The last step is designing the interface on the web server, so it can be accessed by the computer.

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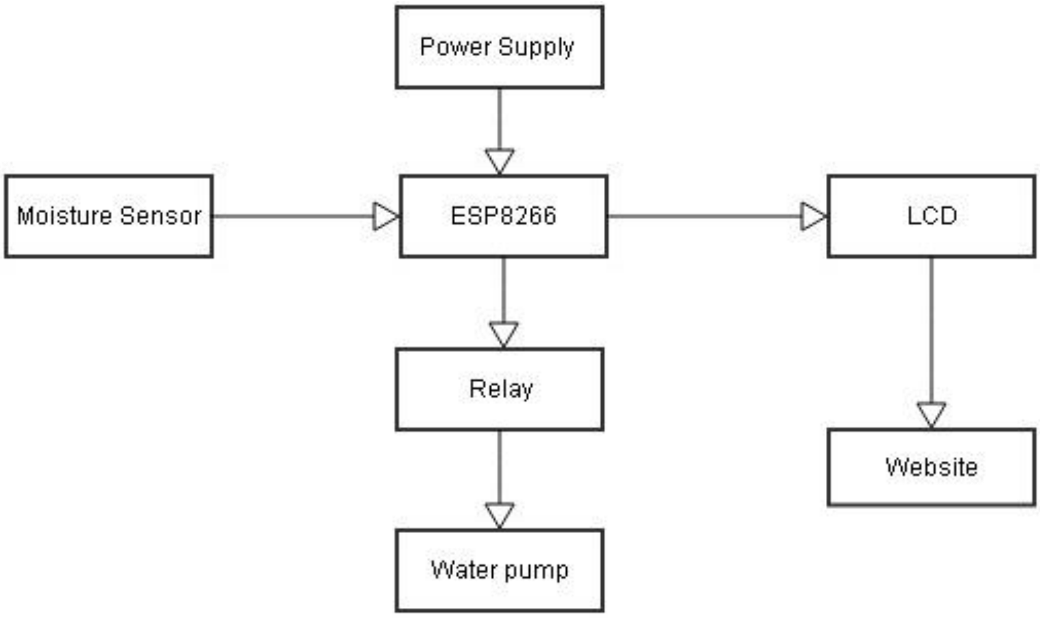


Figure 1. Diagram of the experiment detail

3. Results and discussion

The implementation of the research is started with installing the female connector and male connector on the PCB. The connection will make the pin connection easier on ESP8266. Soil humidity sensor has 4 pins: AO (*Analogue Output*), DO (*Digital Output*), Ground, and Vcc. The output of DO is 1 and 0 or High and Low. The output of AO pin is various depend on the resistance of soil conditions. So, the output from AO pin is used as the input for the microcontroller.

The mechanism of soil humidity sensor is by passed the electric current through the soil. If the soil condition has high humidity, the resistance of the ground will show low value, thus the output voltage will be high. The sensor circuit is tested by comparing the value to the calibrator i.e. Moisture Meter ETP 306. Table 1 presents the result of the testing.

Table 1. The result for sensor series

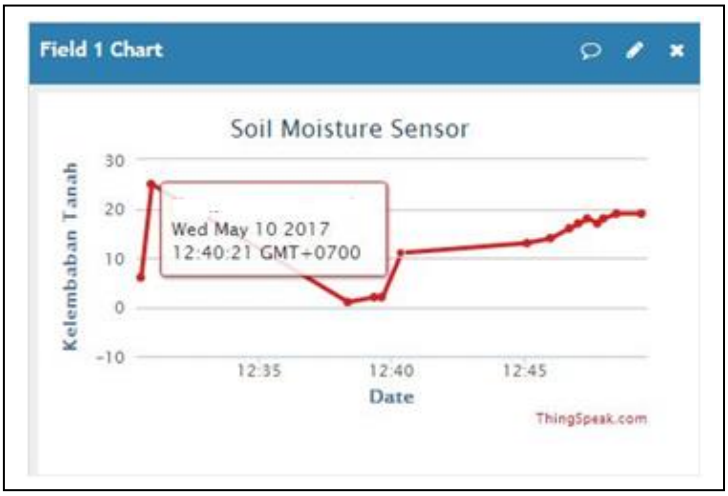
No Test	Calibrator	System	Error Differences
1	10	0%	0%
2	20	19%	5,0%
3	30	28%	6,6%
4	40	37%	7,5%
5	50	46%	8,0%
6	60	59%	1,6%
7	70	67%	4,3%
8	80	76%	5,0%
9	90	86%	4,4%
10	100	95%	5,0%
	Average value		**4,7 %**

The final testing has done with various humidity conditions. The system will turn on the water pump if the humidity below 15% and automatically turn it off when the humidity reaches 45%. Table 2 presents various scenarios for testing the system. The soil humidity monitoring has been successfully displayed in the website using internet network. Figure 2 presents the value on the LCD display and in the websites which has the same numeral.

Table 2. Automation System Testing

No.	Soil Humidity	Water Pump	Respond time (s)
1	3%	On	1,71
2	11%	On	1,50
3	14%	On	2,17
4	26%	On	1,32
5	32%	On	0,92
6	48%	Off	0,83
7	36%	Off	0,78
8	28%	Off	1,37
9	61%	Off	1,50
10	82%	Off	0,79
Average time		1,29 s	

(a)



(b)

Figure 2. Monitoring the humidity on (a) LCD display (b) online website

As presented on Figure 2, the value of the soil humidity on the LCD display has same value with the graphic on the website. The respond time for display the value in the website depends on the internet connection speed of the computer that is used to access the value.

4. Conclusion

The automation system for watering the plant based on the soil humidity value from the sensor has successfully built. The system will turn on the water pump while the soil humidity below 15% and automatically turn it off when the value of soil humidity reaches 45% with the average respond time about 1,29 second. The value of soil humidity can be accessed online and real time in the website.

Acknowledgments

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References

[1] L Eadie, C Stone, R Burton, J DeBerardinis, M Lyons, B Talam and A Perrine 2012 *Farming Smarter , Not Harder, Securing our agricultural economy* Australia
[2] A A Bakhtiari and A Hematian 2013 Precision Farming Technology, Opportunities and Difficulty *Int. J. Sci. Emerg. Technol. with Latest Trends* **5** 1 1–14
[3] Intel World Ahead Program 2012 *eAgriculture : Using Technology to Empower Farming Communities* Bangalore India
[4] S Romeo 2016 Enabling Smart Farming through the Internet of Things Current Status and Trends in *Sensing Technologies for Effective Land Management Workshop*
[5] S Kulkarni 2011 Innovative Technologies for Water Saving in Irrigated Agriculture *Int. J. Water Resour. Arid Environ.* **1** 3 226–231
[6] A Henrique, D Mendes, L Cesar and D Drumond 2011 Multiplatform automated system for monitoring and sprinkler irrigation control *Rev. Sist. Inf. Da FSMA* **8** 2–7
[7] Z Li-ming, L He-ping and Z Bing 2012 The System of Water-Saving Irrigation based on WSN and MSIF *Int. J. Comput. Sci. Issues* **9** 6 474–480
[8] J Jiao, H Ma, Y Qiao, Y Du, W Kong and Z Wu 2014 Design of Farm Environmental Monitoring System Based on the Internet of Things *Adv. J. Food Sci. Technol.* **6** 3 368–373
[9] X Wang and N Liu 2014 The application of internet of things in agricultural means of production supply chain management *J. Chem. Pharm. Res.* **6** 7 2304–2310