Journal of Industrial Automation and Electrical Engineering
Vol. 02, No. 02, December 2025, pp. 170~174
ISSN: 3089-1159

Design and construction of Water Level Control (WLC) at Minangkabau International Airport

Yoga Hendriansyah[1], Syaiful Islami[1]
[1]Department of Electrical Engineering, Faculty of Engineering, Universitas Negeri Padang, Padang, Indonesia

Article Info

Article history:

Received July 30, 2025
Revised August 30, 2025
Accepted October 25, 2025

Keywords:

Water Level Control Omron 61F-GP-N
Automatic Water Pump Control
Control Panel

ABSTRACT

This study aims to design an automatic water pump control system using the Omron 61F-GP-N Water Level Controller (WLC) to overcome energy waste and damage due to manual operation. The system is designed in two modes: automatic based on a water level sensor and manual via a push button, with main components such as a contactor, thermal overload relay (TOR), indicator, and control panel. In automatic mode, the pump turns on when the water is below the lower limit and turns off when it reaches the upper limit. Test results show that the system works according to its expected function, with an average response time of 0.4 seconds between the sensor and the motor. The motor is capable of flowing water of 1.51 m³/minute, with a working current during charging of 9.75 A. The WLC also shows excellent performance with an average voltage of 7.56 V and a current of only 0.08 mA, indicating the efficiency and stability of the sensor's work. In conclusion, this system is effective and applicable, and is able to improve the efficiency and reliability of water pump control. For further development, it is recommended to compare this sensor with other types and design alternative similar sensors that are more economical so that they can be widely used by the community.

Corresponding Author:

Syaiful Islami
Department of Electrical Engineering, Faculty of Engineering, Universitas Negeri Padang
Kampus UNP Pusat, Jl. Prof. Hamka, Air Tawar, Padang 25131, Indonesia
Email: syaiful_islami@ft.unp.ac.id

1. INTRODUCTION

Water is a vital resource for human life, making its availability and management crucial in various sectors, including households, industry, and public facilities. In water management systems, water pumps play a key role in moving water from one location to another, such as from a well to a storage tank. However, manual pump operation is still common, leading to a number of problems, such as delayed filling, wasted electrical energy, and potential motor damage due to overworking or running dry when the pump is running without water [1],[2].

With the advancement of technology, various automation systems have been implemented to improve the efficiency, reliability, and safety of water pump operation. One increasingly popular approach is the use of automatic water level sensors, which can detect the water level in the tank and automatically control the pump operation without human intervention. These sensors work by sending a signal to the actuator (usually a motor or pump) when the water level reaches a certain threshold, either during filling or emptying.

One of the sensors widely used in water level control is the Omron 61F-GP-N Water Level Controller (WLC), which operates on the principle of water conductivity through electrodes. This sensor has high sensitivity and is capable for providing a fast response in controlling water pumps, as well as low power consumption, which supports energy efficiency [3],[4]. This system makes pump operation more automated, energy efficient, and can reduce the risk of damage due to human error.

This research aims to design and implement an automatic water pump control system using the Omron 61F-GP-N WLC sensor combined with a manual mode as a backup. The system circuit includes main components such as contactors [5], thermal overload relays (TOR) [6] push buttons, indicators [7] and control panels, and can operate in two modes: automatic and manual. Automatic mode uses a sensor to detect the water level [8] while manual mode can be activated by the operator via the control button [9].

The results of the study showed that the Omron 61F-GP-N WLC sensor was able to empty the water tank with an average discharge of 1.51 m^3 per minute, with a motor working current of 9.75 A. Seven trials showed that the average response time of the sensor to the pump was around 0.4 seconds, with an average tank emptying duration of 66 minutes. The sensor also showed stable performance with an average voltage of 7.56 Volts and a very small current of 0.08 mA. This shows that the sensor works efficiently and is responsive to changes in water levels. With this performance, this control system can be a practical and economical solution for the general public. In addition to improving the efficiency of the water distribution system, this system also has the potential to reduce operational costs and minimize device damage due to operational errors. This research also provides recommendations for the development of similar sensors that are more affordable while maintaining high sensitivity and reliability for widespread implementation across a wide range of communities.

2. METHOD

This research uses an experimental method with a design approach for an automatic water pump control system using the Omron 61F-GP-N Water Level Controller (WLC) sensor. The main objective of this research is to test the sensor's performance in controlling the pump based on changes in the water level in the tank, both in automatic and manual modes. This sensor works on the principle of water conductivity, where three electrodes, namely High (H), Common (C), and Low (L), are installed in the tank to detect the water level and regulate the pump's on-off conditions automatically via a contactor [10]. This system is also designed to have a manual mode using a push button, so the operator can control the pump directly if needed.

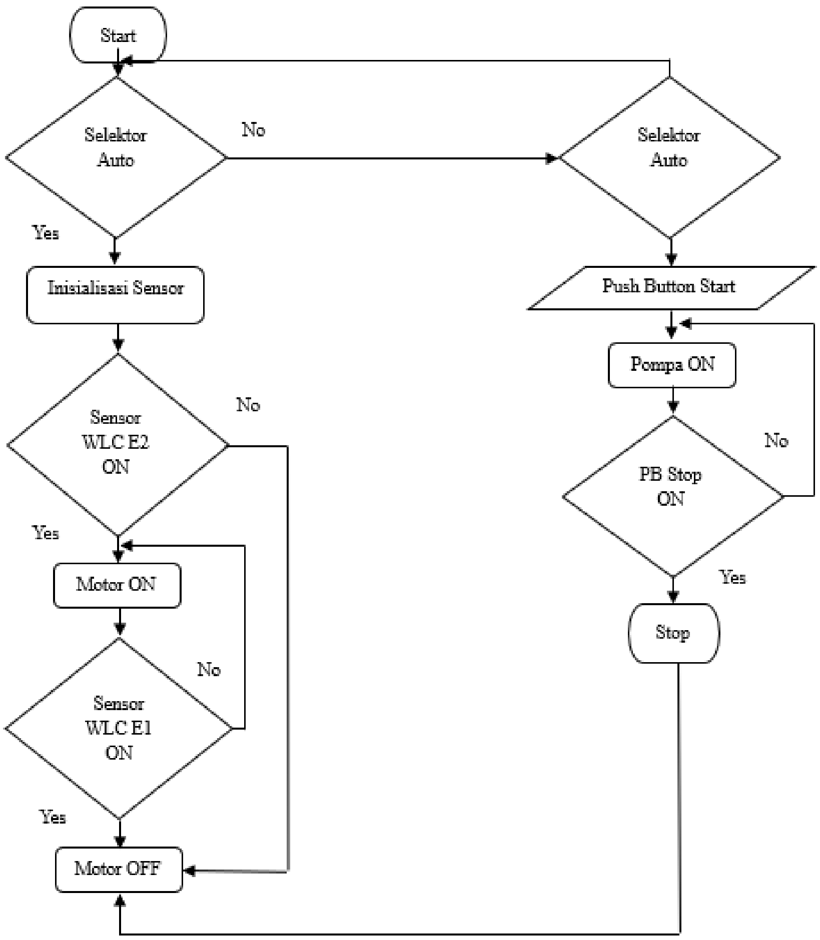

Figure 1. Research Flowchart

The initial steps of the research began with the identification of system requirements and literature studies related to water level sensors, motor operating principles, and pump control systems [11]. After that, the electrical circuit and control panel were designed, followed by the installation process of components such as sensors, contactors, motors, and wiring on the panel. The next stage was a comprehensive system test, which was conducted at the Electrical Installation Laboratory in the month of [insert month/year of implementation]. The test was carried out seven times emptying the water tank to test the sensor response, emptying duration, and system power consumption [12]. The main parameters observed in this test included: motor current (A), working voltage (V), sensor response time (s), and water emptying flow rate (m³/min). Data were obtained using a digital multimeter for voltage and current measurements, as well as a stopwatch and manual water flow meter to measure the duration and capacity of the emptying [13].

The test results were analyzed quantitatively descriptively. The analysis was carried out by calculating the average of each measurement parameter and comparing the sensor performance to the ideal sensor criteria, namely fast response time (<0.5 seconds), low operating current, and stable working voltage [14],[15]. The average tank emptying time was recorded at 66 minutes, with a water discharge of 1.51 m³ per minute and a motor working current of 9.75 A. The sensor showed an average response time of approximately 0.4 seconds and a working voltage of 7.56 V with a current of 0.08 mA, indicating good and stable performance during the test. The research implementation flow is described through the flowchart in Figure 1.

With this method, it is hoped that the automatic control system based on the Omron 61F-GP-N WLC sensor can be an effective solution for controlling water pumps precisely, energy-efficiently, and can be implemented widely, both in the industrial and household sectors

3. RESULTS AND DISCUSSION

This study aims to test and analyze the performance of the Omron 61F-GP-N Water Level Controller (WLC) sensor in controlling a water pump automation system based on the water level in the tank. Testing was conducted seven times by emptying the tank to observe the stability, sensitivity, and efficiency of the designed control system.

Test results showed that the system could empty 1.51 m³ of water per minute. During the tank filling and emptying process, the motor consumed 9.75 amperes of current. This value is considered stable for a 3-phase water pump load and indicates that the sensor is working effectively in providing ON/OFF commands to the pump motor. Current of waterpump motor is shown in Figure 2.

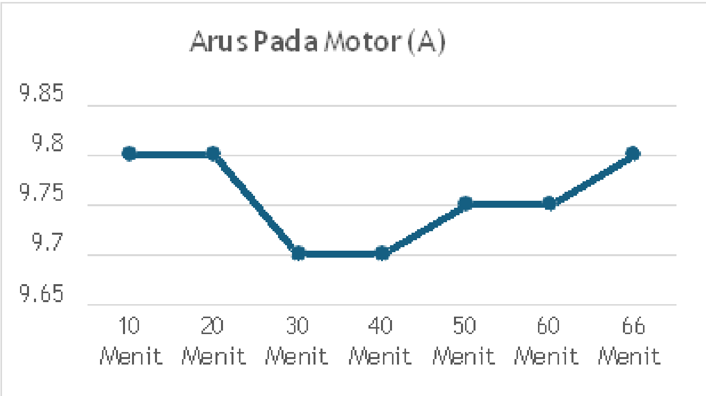

Figure 2. Current of waterpump motor

The Omron 61F-GP-N WLC sensor exhibits high sensitivity, with the average time from the electrode detecting a change in water level to the motor responding being 0.4 seconds. This demonstrates the sensor's fast and accurate response to changes in the tank's water level. This timeframe also meets the ideal criteria for fluid control systems that require high speeds to prevent sudden tank overflows or emptying. Based on the average of seven tests, the time required to completely empty the tank was 66 minutes. This duration was consistent across tests, indicating stable system performance from both the pump and the control sensors. Table 1 and Figure 3 present the WLC sensor voltage data during the multiplication test from empty to full tank.

Table 1. WLC sensor voltage data

No	Time (Minute)	Voltage (Volt)
1	10	8
2	20	8
3	30	7,5
4	40	8
5	50	7
6	60	8
7	66,08	7

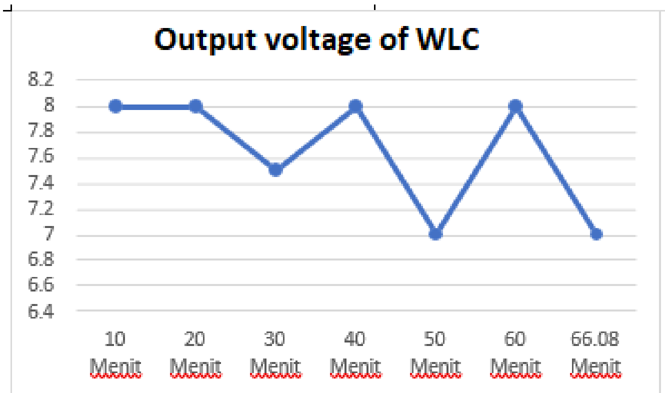

Figure 3. Voltage of WLC

Measurement results show that the Omron WLC sensor produces an average voltage of 7.56 volts and a current of 0.08 mA during operation. The relatively stable voltage and very low current indicate that this sensor has very efficient power consumption. This is a key advantage of the Omron sensor in terms of energy efficiency and the long-term sustainability of automation systems.

Table 2. WLC Performance

Test	Voltage (V)	Current (mA)
1st	7.65	0.08
2nd	7.35	0.08
3rd	7.64	0.07
4th	7.42	0.09
5th	7.52	0.08
6th	7.64	0.08
7th	7.71	0.08

Based on the overall testing, it can be concluded that the automatic water pump control system designed using the Omron 61F-GP-N WLC sensor has excellent performance. The sensor demonstrates precise detection capabilities, low power consumption, and fast response times. The system has also been tested in both automatic and manual modes, and both performed as designed. This reliability opens the potential for wider use of similar sensors, including in domestic and industrial water treatment.

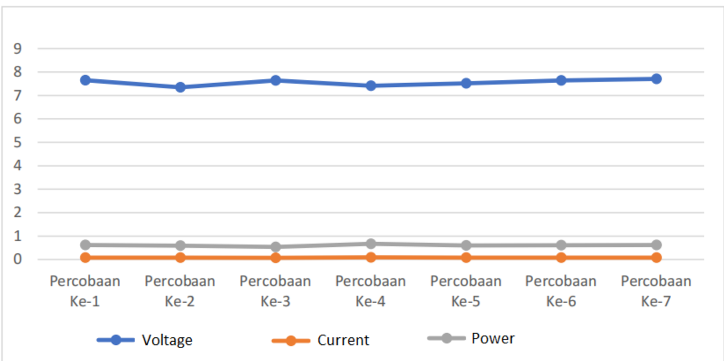

Figure 4. Performances of WLC

4. CONCLUSION

Based on the results of research that has been conducted on the automatic control system of water pumps using the Omron 61F-GP-N WLC sensor, it can be concluded that the designed system is able to work effectively and efficiently in regulating the water level in the tank. The motor controlled by this sensor is able to empty 1.51 cubic meters of water per minute, with a current consumption of 9.75 Amperes, which shows stable working performance on the water pump load. The Omron 61F-GP-N WLC sensor also shows a very high level of sensitivity, where the average response time is only about 0.4 seconds to provide a control signal to the pump based on changes in the detected water level, as well as an average time to empty the tank for 66 minutes. In addition, in terms of energy efficiency, the sensor works with an average voltage of 7.56 Volts and a current of 0.08 mA, which reflects very low and stable power consumption. Overall, this Omron WLC sensor- based control system is proven to have good performance, responsiveness, and energy efficiency, making it suitable for application in various automatic water control systems both on a household and industrial scale.

REFERENCES

[1] K. S, S. S. Nath, C. S and K. D, "Smart Water Level Indicator and Control System Using Arduino Uno and Bluetooth," *2024 10th International Conference on Electrical Energy Systems (ICEES)*, Chennai, India, 2024, pp. 1-5, doi: 10.1109/ICEES61253.2024.10776937.

[2] D. Wijaya and H. Putra, “Automatic Water Level Monitoring System Using Sensor Technology,” *J. Smart Syst. Technol.* Vol. 10, no. 1, pp. 23–25, 2022.

[3] M. H. Ridwan, M. Yuhendri, and J. Sardi, “Sistem Kendali Dan Monitoring Pompa Air Otomatis Berbasis Human Machine Interface,” *JTEIN J. Tek. Elektro Indones.*, vol. 4, no. 2, pp. 592–600, 2023.

[4] R. Anwar, “Analysis of Energy Consumption in Automated Water Pump Systems,” *Jaounal Renew. Energy Smart Grid,* vol. 15, no. 2, pp. 67–80, 2022.

[5] B. S. Kumar, S. Ramalingam, S. Balamurugan, S. Soumiya and S. Yogeswari, "Water Management and Control Systems for Smart City using IoT and Artificial Intelligence," *2022 International Conference on Edge Computing and Applications (ICECAA)*, Tamilnadu, India, 2022, pp. 653-657, doi: 10.1109/ICECAA55415.2022.9936166.

[6] C. P and P. Sathiyapriya, "AI-IoT Based Smart Water Management System for Smart City and Rural Development," *2025 International Conference on Emerging Technologies in Engineering Applications (ICETEA)*, Puducherry, India, 2025, pp. 1-5, doi: 10.1109/ICETEA64585.2025.11100005.

[7] M. Yuhendri, A. Aswardi, and A. Ahyanuardi, “Implementasi Pompa Air Tenaga Surya Menggunakan Inverter Boost Satu Fasa,” *INVOTEK J. Inov. Vokasional dan Teknol.*, vol. 20, no. 3, pp. 1–10, 2020, doi: 10.24036/invotek.v20i3.813.

[8] A. Dhanraj, S. Sharma, D. Pethe and M. Bhanja, "Android Based App Development for Remote Logging and Control with Smart Home Watering System," *2024 International Conference on E-mobility, Power Control and Smart Systems (ICEMPS)*, Thiruvananthapuram, India, 2024, pp. 1-6, doi: 10.1109/ICEMPS60684.2024.10559276.

[9] M. Yuhendri, A. Aswardi, and H. Hambali, “Implementasi Pompa Air Otomatis Tenaga Surya Untuk Rumah Ibadah,” *JIPEMAS J. Inov. Has. Pengabdi. Masy.*, vol. 3, no. 2, p. 166, 2020, doi: 10.33474/jipemas.v3i2.6758.

[10] P. B. Agarkar, A. V. Dange, T. K. Adhav, N. Sangle and N. D. Kapale, "Efficient Water Resource Management: An IoT-Based Smart Water Level Monitoring and Control System," *2023 4th International Conference on Computation, Automation and Knowledge Management (ICCAKM)*, Dubai, United Arab Emirates, 2023, pp. 1-5, doi: 10.1109/ICCAKM58659.2023.10449619.

[11] S. Qiu, H. Xu, Z. Fang, R. Song, Z. Wang and Y. Zhang, "Research and Application of Drum Water Level Control in Power Plant Based on Fuzzy Control," *2019 IEEE 3rd Advanced Information Management, Communicates, Electronic and Automation Control Conference (IMCEC)*, Chongqing, China, 2019, pp. 1282-1285, doi: 10.1109/IMCEC46724.2019.8983910.

[12] Y. Qiliang, X. Jianchun and W. Ping, "Water Level Control of Boiler Drum Using One IEC61131-3-Based DCS," *2007 Chinese Control Conference*, Zhangjiajie, China, 2007, pp. 252-255, doi: 10.1109/CHICC.2006.4347120.

[13] Y. A. Putra and M. Yuhendri, “Smart Monitoring Pompa Air Otomatis Berbasis Human Machine Interface Dan Internet Of Things,” *JTEIN J. Tek. Elektro Indones.*, vol. 4, no. 2, pp. 863–876, 2023.

[14] Y. -K. Wang, J. -S. Wang, X. -P. Gao and X. -H. Fang, "Design of water level control system high pressure heater in power plant based on Honeywell TPS," *2018 Chinese Control And Decision Conference (CCDC)*, Shenyang, China, 2018, pp. 3612-3617, doi: 10.1109/CCDC.2018.8407749.

[15] L. M. Adesina, O. Ogunbiyi, and B. Jimada-Ojuolape, “Development of water level controller with SMS capability,” *ABUAD Journal of Engineering Research and Development*, vol. 7, no. 1, pp. 195 - 207, 2024.