Evolution in Electrical and Electronic Engineering Vol. 3 No. 2 (2022) 793-800

EEEE

Homepage: http://publisher.uthm.edu.my/periodicals/index.php/eeee
e-ISSN: 2756-8458

Water Flow, Temperature, and PH Monitoring Based on the Internet of Things (IoT)

Ibrahim Ariff Ramli[1], Dirman Hanafi[1]*

Faculty of Electrical and Electronic Engineering,
Universiti Tun Hussein Onn Malaysia, 86400 Parit Raja, Johor, MALAYSIA

*Corresponding Author Designation

DOI: https://doi.org/10.30880/eeee.2022.03.02.093
Received 03 March 2022; Accepted 02 October 2022; Available online 30 October 2022

Abstract: The hardware of the water flow sensor was successfully designed. It is connected with the pipe at home to get the flow rate and volume of water. The temperature sensor is placed in a container with contains different water temperatures. The PH sensor was also placed on a container containing three different solutions. The designed water flow sensor was successfully tested using a water pipe at home. The flow rate and volume successfully display on the Blynk application. The flow rate is displayed on the gauge widget on Blynk and the volume is displayed on the LCD widget. The temperature sensor is well tested in a container that contains hot water and cold water. The value of temperature water is successful display on the LCD widget on the Blynk application. The designed PH sensor was successfully tested in a container that contain vinegar solution, pure water solution, and soap solution. The value of PH is successful display on the LCD widget on Blynk. The collected data of flow rate on the first test at three locations shows between 100 L/h and 266 L/h. For temperature, the highest value of temperature is 68°C obtained from thermometer while using temperature sensor is 70°C which is average error is 5%. For the PH sensor, the first test is using vinegar solution. The lowest value obtained from the sensor is 2.322 and the highest value obtained is 2.347. The second test is using a pure water solution. The lowest value obtained from the sensor is 7.412 and the highest value obtained is 7.422. The third test is using the solution. The lowest value obtained from the sensor is 10.91 and the highest value obtained is 10.98.

Keywords: Water Flow, Temperature, PH, IoT

1. Introduction

To reduce expenses from high to low, the switch from a manual to an automatic system is gaining traction in several industries. For example, water supply companies need the results of water flow monitoring research and innovation to develop a successful and effective system. The suggested solution enables users to track and forecast water consumption online using a computer or mobile device, enabling them to schedule their activities accordingly [1].

**Corresponding author: dirman@uthm.edu.my*

Water measurement is a crucial element in water management systems since efficient water management requires supplying water based on actual demand. The quantity of water flowing through the pipe can be measured using a wide range of water flow measuring methods and water flow meters, but they are all excessively expensive. The development of a low-cost automatic system necessitates the use of inexpensive temperature, PH, and water flow sensors [2].

The water flow sensor determines the water flow rate. The leakage detection is found in the pipe due to two differences in the water flow sensor, which is placed in the pipe at a longer distance and senses the water flow through the pipe [3]. Therefore, in urban areas, we need to monitor the supply of water continuously and distributed it equally [4]. The term "Internet of Things" (IoT) describes the automatic linking of devices across wired and wireless networks. There is no requirement for human involvement in this system's operation. [5].

2. Materials and Methods

The proposed system's entire algorithm is shown in Figure 1. Initially, the ESP WIFI module and the Blynk server are initialized the three sensors are connected and the values are read from the sensors. The working algorithm of the water flow sensor, PH sensor, and temperature sensor are explained in a flowchart. The temperature sensor reads the analog values of temperature and sends them into the Blynk server and then updates the serial monitor.

2.1 Project Working Algorithm

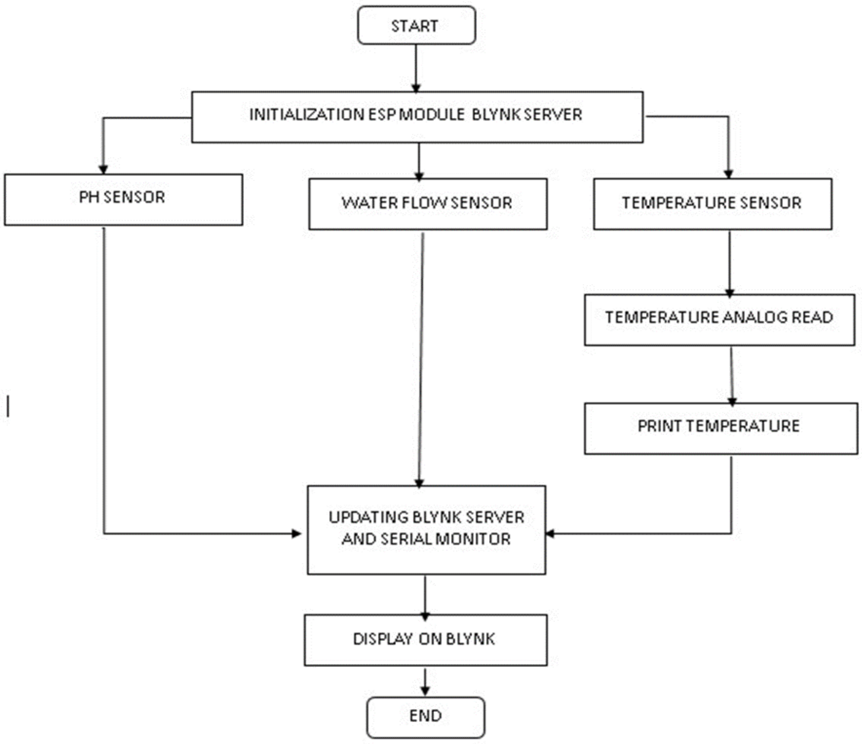

Figure 1: **Project Working Algorithm**

2.2 Block Diagram

The proposed system in Figure 2 uses three sensors which are water flow, PH, and temperature. The microcontroller unit houses one ESP8266 Wi-Fi module and the primary processor module (NodeMCU). Due to its small size and low power consumption, the microcontroller unit is an important component of the system created for measuring water flow and water quality. Three sensors are used, one of which, a temperature sensor, collects data in the form of analogue signals, while the other two have outputs that are directly connected to the digital pins of the MCU units. The MCU processes all of the sensor data and updates it to the central server using the Wi-Fi data connection module ESP8266 (NodeMCU).

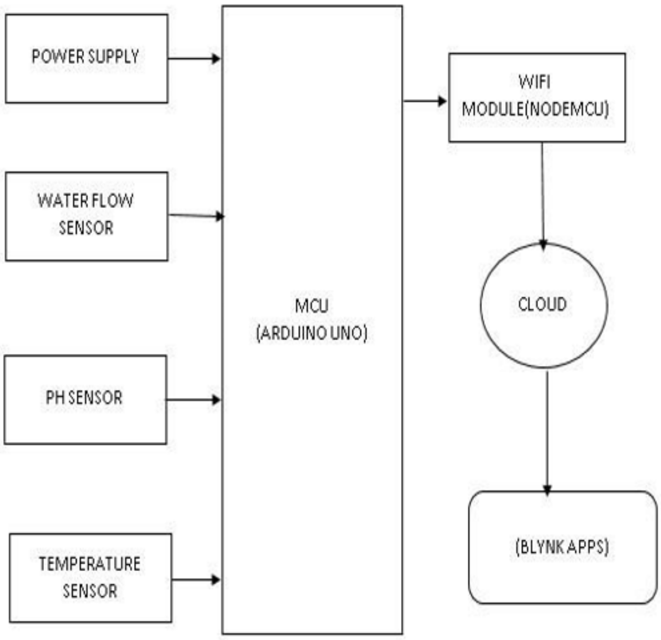

Figure 2: **Block Diagram of the Project**

3. Results and Discussion

The hardware of this project has been developed by referring to the circuit design. The figure shows the view of the project hardware. All the components and sensors are linked together to get a test result as shown in Figure 3.

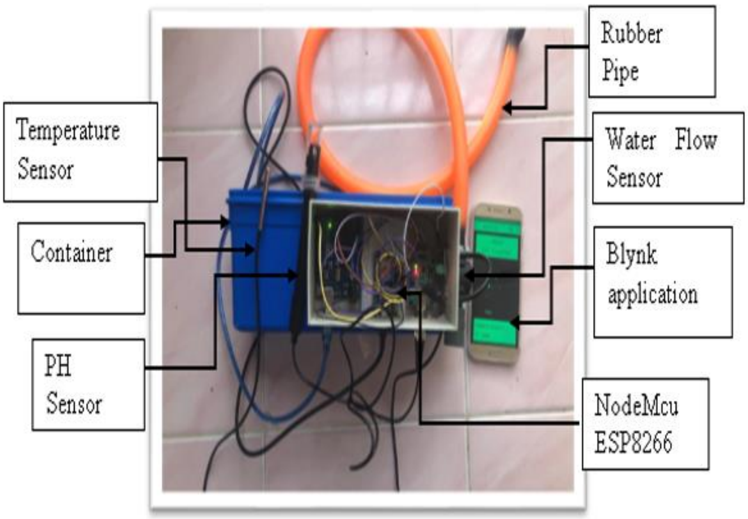

Figure 3: **View of Water Flow Sensor System**

3.1 Water Flow Sensor Hardware Testing

Figure 4 indicates the prototype testing at three different locations.

Kitchen Toilet Front Yard

Figure 4: **Prototype testing at three different locations**

This system has been tested at three different locations which are the kitchen, toilet, and front yard. Three locations were chosen based on the location pipe of water at this house. The data will be taken three times a day. The data of flow rate will display at Blynk apps when the water flows through the water flow sensor Table 1 shows the summary data collected from the Blynk webserver.

Table 1: **Summary Data Collected from the Blynk Webserver**

Location	Time	Min Flowrate(L/h)	Max Flowrate(L/h)	Min speed(m/s)	Max speed(m/s)
Kitchen	9:00-9:05	103.32	103.34	0.36542	0.36549
	12:45-12:50	100.73	99.1	0.35626	0.35049
	5:00-5:05	99.41	109.42	0.35159	0.38699
Toilet	9:00-9:05	238.91	244.76	0.84497	0.86566
	12:45-12:50	250.64	243.5	0.88646	0.86121
	5:00-5:05	228.47	222.42	0.80805	0.78665
Front yard	9:00-9:05	262.26	256.04	0.92756	0.90556
	12:45-12:50	266.19	260.99	0.94145	0.92306
	5:00-5:05	246.22	268.45	0.87083	0.94945

The data in Table 1 shows the different values at different locations. When a water flow sensor is applied in the kitchen, the minimum and maximum water flowrate can be obtained. From the value of flow rate, the maximum and minimum speed of water also can be calculated using the formula. The speed of water shows from the data above when the flow rate of water is high, the speed of water also increases. The different value of flow rate occurs because of the different location. The highest water flow rate is located in the front yard because of the pipe near the source of water. The pressure of water also affects the flow rate. For example, the size of the pipe in the kitchen is bigger than the size pipe in the toilet. Although the location of both places is near, the flow rate shows differently because of pipe pressure.

3.2 Temperature sensor Test

Figure 5 shows the prototype testing of the temperature sensor.

Figure 5: **Prototype testing of the temperature sensor.**

Data from Table 2 were obtained from the temperature sensor. When the sensor is placed at different temperatures of water, the value will display in the Blynk apps. For comparison, the actual temperature will be tested first using a temperature detector. After that, the measured value will be compared with the actual value to get how much error will get. From that, the performance of the temperature sensor will be analyzed. The actual value of temperature is obtained from a thermometer. For example, the hot water, water, and cold water has been tested using a temperature sensor and thermometer. Then the data is taken from both methods. From both values of temperature, the comparison is made. The value of error was obtained from the value displayed on Blynk and the thermometer. The average error shows it is still below 10% which is 5%. The error occurs because room temperature affects water temperature.

Table 2: **Measured Value and Actual Value Temperature of The Water**

Measured value(°C)	Actual value (°C)	Error (%)	Blynk Display
70.00	68.00	2.86	Temperature: 70.000
58.50	54.78	6.36	Temperature: 58.500
30.50	28.90	5.25	Temperature: 30.500
16.50	15.60	5.45	Temperature: 16.500
11.00	10.45	5.00	Temperature: 11.000
Average Error		5.00	

3.3 PH sensor Test

Figure 6 indicates the prototype testing of the PH sensor. Three solutions will be tested which are vinegar solution, pure water solution, and soap solution.

Vinegar

Pure water

Soap

Figure 6: **Prototype testing of PH sensor**

Five values of PH were taken based on the vinegar solution. The measured value is taken from the PH sensor while the actual value is the standard value of this solution. The PH sensor will be put into the solution to make a comparison with the actual value. The results are shown in the following in Table 3.

Table 3: Vinegar Solution

Measured value	Actual value	Error (%)	Blynk Display
2.322	2.5	7.6	pH Value: 2.322
2.337	2.5	7.0	pH Value: 2.337
2.338	2.5	6.9	pH Value: 2.338
2.340	2.5	6.8	pH Value: 2.340
2.347	2.5	6.5	pH Value: 2.347
Average Error		7.00	

The standard value of the vinegar solution will be compared with the measured value using a PH sensor. The value standard of vinegar solution is 2. From both values, the performance of the PH sensor will be analyzed. Vinegar is a highly acidic substance. The pH of vinegar varies according to the vinegar type. White distilled vinegar, which has a pH of around 2.5 at a specific point, is the best-distilled vinegar for cleaning. When used vinegar in small amounts as recommended in many of the recipes found online, vinegar will not harm pipes. It doesn't matter if the pipes are made of PEX, PVC, Copper, or another material. Water pipes will not be harmed by vinegar. The data from the table above shows a different value of PH value from the vinegar solution. From both values of PH values, a comparison is made. The average error shows it is still below 10% which is 7% as shown in Table 4.

Table 4: Pure Water Solution

Measured value	Actual value	Error (%)	Blynk Display
7.412	7	5.6	pH Value: 7.412
7.414	7	5.6	pH Value: 7.414
7.417	7	5.6	pH Value: 7.417
7.421	7	5.6	pH Value: 7.421

7.422	7	5.7	pH Value: 7.422
Average Error		5.62	

The standard value of pure water solution will be compared with the measured value using a PH sensor. The value standard of pure water solution is 7. From both values, the performance of the PH sensor will be analyzed. Pure water has a pH of 7 and is classified as "neutral" because it lacks both acidic and basic properties. Even PH of pure water solution is 7, the measured value tested by the PH sensor shows higher than the actual value. It is caused by water supply from the government mixed with chlorine. The data from the table above shows a different value of PH value from pure water solution. From both values of PH values, a comparison is made. The average error shows it is still below 10% which is 5.62% as shown in Table 5.

Table 5: **Soap Solution**

Measured value	Actual value	Error (%)	Blynk Display
10.91	9	17.5	pH Value: 10.91
10.92	9	17.5	pH Value: 10.92
10.94	9	17.7	pH Value: 10.94
10.97	9	18.0	pH Value: 10.97
10.98	9	18.0	pH Value: 10.98
Average Error		17.74	

The value standard of pure soap solution is 9 From both values, the performance of the PH sensor will be analyzed. With a pH of around 9-10, cold process soap is naturally alkaline. This pH balance helps in the gentle cleansing of the skin. The pH of sodium hydroxide lye is about 14, which puts it at the very top of the pH scale. When too much lye is used in the soap, the pH level rises above the normal range of 9-10 and can approach 11-14. The data from the table above shows a different value of PH value from the soap solution. From both values of PH values, a comparison is made. The average error shows it under 10% which is 17.74%. It shows a high sensitivity to PH, especially in alkaline solutions.

4. Conclusion

The shift from a manual to an automatic system is gaining traction in a variety of industries, intending to lower costs from high to low. Water supply companies, for example, need the outcomes of water flow monitoring research and innovation to create an effective and productive system. The proposed system helps to monitor and forecast the water consumption made by the system through the internet by mobile or computer so that users can schedule their activities according. The prototype proposed in this work was successfully measured and displayed on the Blynk application.

Acknowledgement

The authors would like thanks to the Faculty of Electrical and Electronic Engineering (FKEE), University Tun Hussein Onn Malaysia (UTHM) for assisting me in completing this final year project.

References

[1] G. Gosavi, G. Gawde and G. Gosavi, "Smart water flow monitoring and forecasting system," 2017 2nd IEEE International Conference on Recent Trends in Electronics, Information & Communication Technology (RTEICT), Bangalore, India, 2017, pp. 1218-1222, doi: 10.1109/RTEICT.2017.8256792

[2] A. Jamaluddin, D. Harjunowibowo, D. T. Rahardjo, E. Adhitama and S. Hadi, "Wireless water flow monitoring based on Android smartphone," 2016 2nd International Conference of Industrial, Mechanical, Electrical, and Chemical Engineering (ICIMECE), Yogyakarta, Indonesia, 2016, pp. 243-247, doi: 10.1109/ICIMECE.2016.7910449

[3] M. M. Srihari, "Intelligent Water Distribution and Management System Using Internet of Things," 2018 International Conference on Inventive Research in Computing Applications (ICIRCA), Coimbatore, India, 2018, pp. 785-789, doi: 10.1109/ICIRCA.2018.8597325

[4] M. M. Srihari, "Intelligent Water Distribution and Management System Using Internet of Things," 2018 International Conference on Inventive Research in Computing Applications (ICIRCA), Coimbatore, India, 2018, pp. 785-789, doi: 10.1109/ICIRCA.2018.8597325.

[5] C. S. Patel and J. A. Gaikwad, "Design and Development of IOT Based SMART water distribution network for Residential areas," 2019 International Conference on Communication and Electronics Systems (ICCES), Coimbatore, India, 2019, pp. 2019-2023, doi: 10.1109/ICCES45898.2019.9002053.