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Research Article

Design and Construction of PDAM Water Use Monitoring Based on Internet of Things (IoT)

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A B S T R A C T

Water is a natural resource that is very important for life in the world for humans, animals and other living things. In a settlement, there are two ways to provide clean water, namely piped and non-piped systems. The piping system itself is managed by the Regional Drinking Water Company (PDAM), which is a local government company that carries out the service function to produce drinking water and clean water for the community. The current problem occurs in the community and is detrimental to the community itself, namely the manual recording system of water usage meters, often the fees charged by the community are not in accordance with the usage meter used. For this reason, an automatic monitoring of water usage was designed. This tool uses a Waterflow to detect the amount of water consumption which is controlled with NodeMCU Esp8266, later monitoring of usage can be seen on the LCD and Thinger.io as a database. Testing this final project using a measuring cup as a comparison of the real water volume with the volume of the results read by the sensor. The test results of the final project will read the volume of water and the rate for usage fees with an error percentage of 0.3%. The resulting data can be monitored in real time through the thinger.io website and smartphones to make it easier to monitor remotely.

INTRODUCTION

PDAM is a regional-owned company engaged in the distribution of clean water. Currently, PDAM is still using a water meter recording system manually to find out the amount of clean water used by customers, by means of officers coming directly to homes or office buildings. This makes the measurement system less effective and consumes more time and money. To make it easier for officers to monitor public water use, an automatic water use monitoring system was created [1], [2], [3].

This automatic water usage monitoring system is based on the internet of things (IOT), where the monitoring or monitoring system itself remotely uses the internet network as a medium for sending data from the water meter to a website that acts as a database. By using the IOT (Internet of Things) system users can find out the use of water anywhere by using the internet.[4], [5]. In previous research, the monitoring tool made the results of the data obtained only displayed on the LCD, this is still not effective in providing solutions to facilitate monitoring of water use.[6] Then a tool is made that can be monitored remotely with the aim that users can find out real time usage remotely. The sensor used is *waterflow* which functions to measure the amount of water usage and the cost of water usage bills [7].

The waterflow sensor has a water rotor and a hall effect sensor, when water flows through the sensor the rotor will rotate, the rotor rotation will follow the water flow, the greater the water flow, the faster the rotor rotates. At the end of the rotor there is a magnet, which later this magnet will pass through the hall effect sensor which will read how many turns from the rotor to produce a pulse signal. pulse signal value is then sent to the microcontroller.[8], [9]. a microcontroller that has a processor and memory that aims to store measurement data from the sensor. The microcontroller used is NodeMCU Esp8266, this NodeMCU Esp8266 has the advantage of being able to connect to a wifi network directly, so that after measuring the value of the sensor it can be sent to NodeMCU Esp8266. The value is also directly transferred to the website using the connected Wi-Fi network. This allows users to get real-time data updates [10], [11], [12].

Automatic water usage monitoring system tools are also useful for PDAM officers to work more efficiently and get simpler but more accurate measurement results [13], [14]. for the interface to display the results of water usage volume and water usage costs using an LCD and the Thinger.io website which also functions as a database of water usage monitoring tools. thinger.io can visualize sensor readings in the form of values or graphs and can be viewed in real time and stored immediately so that they can review previous data [15]. The advantage of Thinger.io is that it has an application on a smartphone, making it easier for users to monitor via their respective smartphones. Overall, a PDAM water usage monitoring system tool that can find out the volume of water and billing rates in real time remotely with good accuracy.

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METHOD

The tool design method in the final project is carried out in several stages, consisting of hardware design and software design. The purpose in designing this tool is to determine the constituent components of a tool or system that will be made so that it can solve problems during tool manufacture and get results that are in line with expectations.

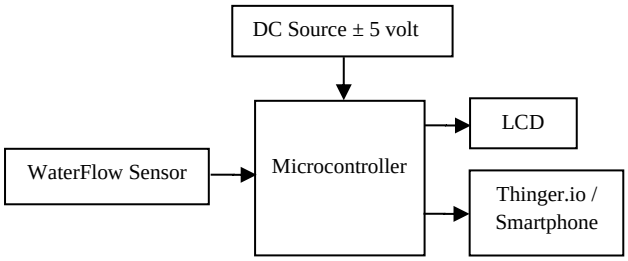

Figure 1. Power System Components

a. sensor waterflow is used to measure the volume and billing rates of water that are detected based on water flow with logical conditions stored in the microcontroller program.
b. The microcontroller is used as a file storage brain from the input process that has been obtained from the sensor which will generate data and send the data to a website which will be displayed on the smartphone.
c. Liquid crystal display (LCD) is used as an output to display data from the sensor in real time.
d. Thinger.io is a website platform for storing database from Arduino to the website which will later be displayed on a smartphone as a monitoring site.

Hardware Design

Hardware design is very important in making this final project. Because with the hardware, it can be tested for real whether this tool can work properly or not. hardware devices consist of waterflow sensors, pipes, control boxes, adapters, NodeMCU Esp8266, and LCD

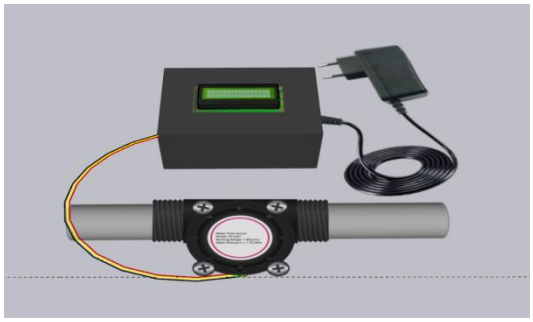

Figure 2. Hardware design

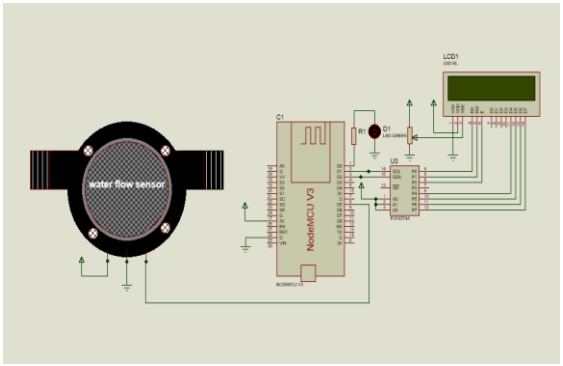

Figure 3. Overall Load Test Circuit

Table 1. Wearing Connecting Cable to NodeMCU ESP8266

Component	Pin NodeMCU Esp8266
Pin sensor water flow	D5
VCC	3V
GND	GND
LCD pin SDA	D2
LCD pin SCL	D1
Anode LED	D0
Cathode LED	GND

In this design the NodeMCU Esp8266 functions as a controller of all components used for the tool to be made. On NodeMCU Esp8266, input file processing occurs from the waterflow sensor, where the input file will be sent to the Thinger.io web which will later be displayed on the smartphone. NodeMCU esp8266 is connected to a Wi-Fi to be able to send the file. In the control box there is an LED as a marker of whether the Wi-Fi is connected or not, and there is a 12x6 LCD as an interface for data results that can be viewed directly.

Software Design

The software used to program NodeMCU Esp8266 in this final project is IDE (Integrated Development Environment).programming language basic, namely C/C++ which is equipped with *a*. The following is a form of *software* IDE.

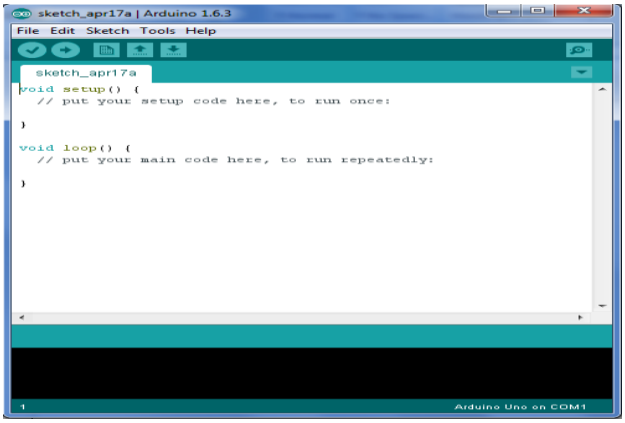

Figure 4. IDE software display

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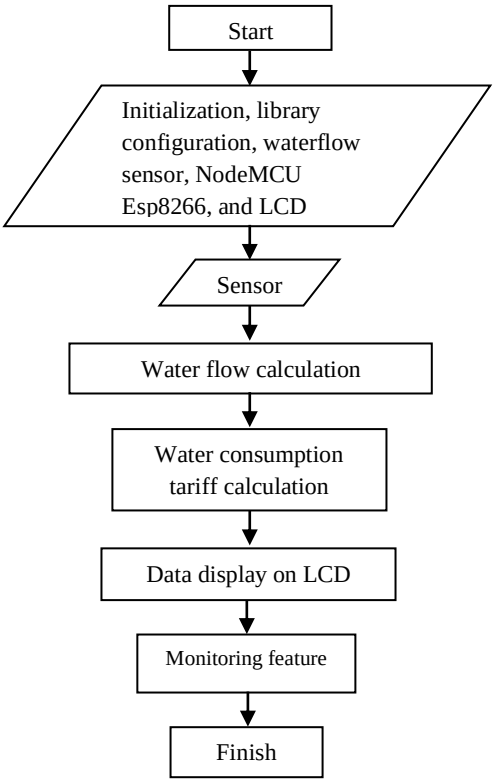
Flowcart



RESULTS AND DISCUSSION

Testing the internet of things-based PDAM water usage monitoring system tool that uses a waterflow sensor to detect the volume of water and calculates the tariff for water usage costs. Tool testing is done manually to find out if the tool is running well, with good reading accuracy. To compare the reading accuracy of the tool, a measuring cup is used so that it can get the percentage error from the tool.

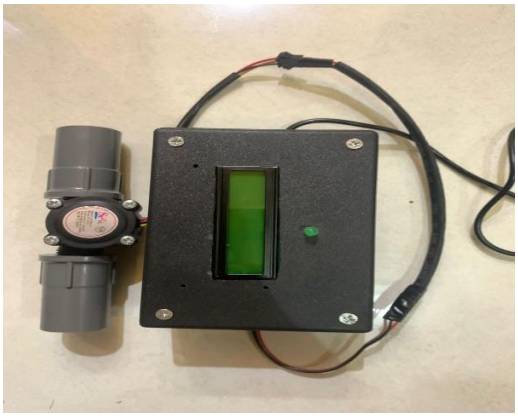


Figure 5. PDAM water usage monitoring system tool

Table 2. Data table of tool accuracy test results

Water volume	Sensor data result	Price rate	Error (%)
1 liter	0.99	2.98	1%
2 liters	1.99	5.95	0.5%
3 liters	3.00	9	0%
4 liters	4.01	12.2	0.25%
5 liters	5.02	15.7	0.4%
6 liters	6.01	18.04	0.16%
7 liters	7.02	21.07	0.28%
8 liters	8.00	23.99	0.%
9 liters	9.01	27.02	0.11%
10 liters	10.03	30.08	0.3%
Total			**0.3%**

$$Er(\%) = \left|\frac{True\ value - Read\ value}{True\ value}\right| \times 100\% \quad (1)$$

$$\%Avg\ Accuracy = \frac{\sum \%Accuracy}{n} \quad (2)$$

$$\%Avg\ Accuracy = \frac{3}{10} = 0.3\% \quad (3)$$

Power accuracy = 100% - 0,3%
Power accuracy = 99,7%

Based on the table and the results of manual measurements can be obtained the percentage value of sensor accuracy is 99,7%. This PDAM water usage monitoring system tool uses an LCD and Thinger.io which functions as a web server to display and store sensor reading data, this data is displayed in real time which is also monitored via a smartphone.

Figure 6. display result on LCD

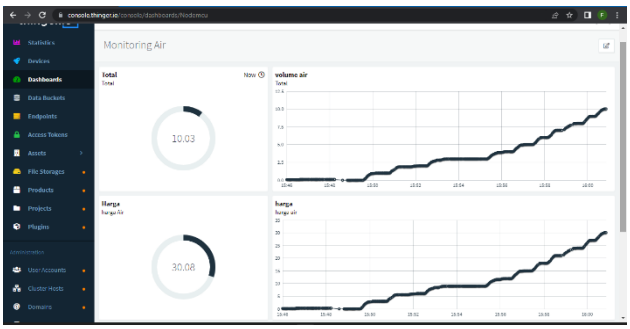


Figure 7. appearance on the web Thinger.io

Figure 8. display on the smartphone application

CONCLUSIONS

Based on the results of testing the PDAM water usage monitoring system based on the internet of things that uses NodeMCU Esp8266 and uses a waterflow sensor to read the volume of water usage and water usage fees, which are equipped with LCDs and LEDs. This tool can be used with an accuracy of 99.7% with 10 trials manually and using a measuring cup as a comparison. This tool can work well when connected to a stable internet to calculate water usage and tariffs, so a good internet connection is needed for every use of the tool. On the thinger.io website, you can monitor and store data so that the data read by the previous sensor can be viewed again.

REFERENCES

[1] Paksi, Y. E. E., Prihartono, E., & Vitianingsih, A. V. (2021). Sistem Monitoring Pemakaian Air Pdam Tirta Kencana Kota Samarinda Berbasis Arduino. JIMP (Jurnal Informatika Merdeka Pasuruan), 5(3).

[2] Wijayanto, D., & Dedi Triyanto, I. (2016). Prototipe Pengukur Debit Air Secara Digital Untuk Monitoring Penggunaan Air Rumah Tangga. *Coding Jurnal Komputer dan Aplikasi*, *4*(3).

[3] Sujadi, H., Mardiana, A., & Permana, A. (2021). Pengembangan Purwarupa Monitoring Tagihan Air Pdam Berbasis Internet Of Things. *Infotech journal*, *7*(2), 9-14.

[4] Mercy, C. (2005). Design, Monitoring and Evaluation Guidebook. *USA: Portland*

[5] Cahyono, G. H. (2016). Internet of things (sejarah, teknologi dan penerapannya). Swara Patra: Majalah Ilmiah PPSDM Migas, 6(3).

[6] Risna, R., & Pradana, H. A. (2014). Rancang Bangun Aplikasi Monitoring Penggunaan Air PDAM Berbasis Mikrokontroler Arduino Uno. Jurnal Sisfokom (Sistem Informasi Dan Komputer), 3(1), 60-66.

[7] Koestoer, R. A. (2004). Pengukuran Teknik. *Departemen Teknik Mesin Fakultas Teknik UI*, 147-149.

[8] Kurniasih, S. S., Triyanto, D., & Brianorman, Y. (2016). Rancang Bangun Alat Pengisi Air Otomatis Berbasis Mikrokontroler. *Coding Jurnal Komputer dan Aplikasi*, *4*(3).

[9] Gunastuti, D. A. (2018). Pengukuran Debit Air Pelanggan Air Bersih Berbasis IoT Menggunakan Raspberry Pi. *EPIC (Journal of Electrical Power, Instrumentation and Control)*, *1*(2), 167-175.

[10] Gunawan, D. (2018). Sistem Monitoring Distribusi Air Menggunakan Android Blynk. ITEJ (*Information Technology Engineering Journals)*, 3(2), 28-36.

[11] Syahwil, M. (2013). Panduan mudah simulasi dan praktek mikrokontroler arduino. *Yogyakarta: Andi*.

[12] Hakim, D. P. A. R., Budijanto, A., & Widjanarko, B. (2018). Sistem Monitoring Penggunaan Air PDAM pada Rumah Tangga Menggunakan Mikrokontroler NODEMCU Berbasis Smartphone ANDROID. Jurnal Iptek, 22(2), 9-18.

[13] Suharjono, A., Rahayu, L. N., & Afwah, R. (2016). Aplikasi Sensor Flow Water Untuk Mengukur Penggunaan Air Pelanggan Secara Digital Serta Pengiriman Data Secara Otomatis Pada PDAM Kota Semarang. *TELE*, *13*(1).

[14] Ramadhan, A. B., Sumaryo, S., & Priramadhi, R. A. (2019). Desain dan Implementasi Pengukuran Debit Air Menggunakan Sensor Water flow Berbasis IoT. *eProceedings of Engineering*, *6*(2).

[15] Sawidin, S., Putung, Y. R., Waroh, A. P., Marsela, T., Sorongan, Y. H., & Asa, C. P. (2021, September). Kontrol dan Monitoring Sistem Smart Home Menggunakan Web Thinger. io Berbasis IoT. In *Prosiding Industrial Research Workshop and National Seminar* (Vol. 12, pp. 464-471).