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Iot-BASED HOME WATER MONITORING USING ARDUINO

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Abstract

There are many problems related to water in Indonesia, ranging from floods to water crises. One of the things we can do is manage water consumption so that we can use water effectively and wisely. The problem of excessive anggd unwise water use can be overcome by water consumption management.. In this study, a water consumption management system incc the household is created, which includes monitoring and control so that we can monitor and control it and also have a history of daily water use. The system will be made using Arduino Uno as controller and will be displayed on the LCD and the website. Based on research, the following conclusions were obtained: Successfully implemented IoT based home water monitoring using Arduino, Successfully designed a tool for water tank management based on Arduino Uno, the results obtained by the tool can detect when the water is full, and the water pump turns off automatically so that the water does not fill again and the tank will not be full. The average error of this system is 6.16 %. The bigger volume will make the error value decrease.

Keywords: Water Consumption, Monitoring, Arduino Uno, Internet of Things

INTRODUCTION

Water is an indispensable source of life by living things, thus, the more the population increases, the more the need for air must be met, there is no human who does not need air such as for daily needs, transportation facilities and as a source of energy for hydropower (hydropower) [1]. Along with the increasing population in Indonesia, the need for water is also increasing. Water serves to meet daily needs such as bathing, washing, cooking and so on. This is natural because water is the main need of mankind in the world. Water is also useful in various industries for example for agriculture, plantations, animal husbandry, and all of them require water as the main raw material. However, until now the use of water has not been matched by public awareness to save water [2]. People are still not aware of the importance of water resources and are not aware of how much water they use per day. In checking water by the PDAM (Regional Drinking Water Company), a process is needed to check the amount of water used that is distributed to each customer every month [3]. The method used is still manual, namely sending officers to customers' homes and recording them one by one [4]. This method is less effective and efficient and requires a lot of energy and takes a lot of time. The water meter used by PDAM is also still analog so that the water usage data is difficult for customers to know [5][6].

The process of monitoring water consumption is still carried out in the conventional way, namely by using a water meter [7]. This checking process is also at the same time to find out the amount of usage in that month by calculating the difference from the current month to the previous month [8]. From the amount of usage, it is used to find out the money that must be paid by multiplying it by the nominal amount of money per unit (liters) [9][10]. The ineffectiveness of the process of checking and controlling this water causes the community to be less efficient in using distribution water considering the current technological developments and can help with these problems [11][12].

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METHODS

In this study, the author makes a solution with a water use monitoring system that can be accessed anytime and anywhere [13]. with the implementation of water reservoir filling automation, so that when the water level and water usage conditions are at a certain level it will open the reservoir filling valve automatically, by utilizing ultrasonic sensors and water discharge sensors with Arduino control [14][15]. Arduino is an open-source hardware and software company, project, and user community that designs and manufactures single-board microcontrollers and microcontroller kits for building digital devices [16]. This data processing will determine the opening and closing of the reservoir filling valve, to determine the opening or closing of the reservoir filling valve, there are several conditions or sensor readings that are used as a reference for this process. in this case the data from the water discharge sensor readings will be sent to the website by applying the IoT principle [17]. This monitoring system can make it easier to monitor household water use [18]. With this system, it is expected to minimize water wastage caused by lack of user supervision, and it doesn't take long and can check water usage without having to bother looking at the meter again [19][20].

A. Water Discharge

Water discharge Water discharge is defined as the volume of fluid that passes through a certain cross-sectional area per unit time. Water flowing in a cross section has a speed so that the water discharge that can be calculated in equation number 1.

$$Q = \frac{V}{t} \tag{1}$$

Q = water discharge (m^3/s)
A = area (m^2)
v = water flow rate (m/s)

B. Sensor Water Flow

YF-S201 as shown in Figure 1 is a water flow measurement sensor consisting of a plastic valve, a water rotor and a hall effect sensor. The working principle of this sensor is that when the flow of water passes through the plastic valve, the magnetic rotor will rotate so as to produce a voltage pulse signal that is proportional to the amount of water that passes through the sensor.

Fig 1. Sensor Water Flow

The voltage pulse signal is in the form of a square wave so that the conversion of flow rate to liters per minute can be formulated in equation 2.

$$Q = \frac{Frekuensi\ Pulsa\ (Hz)}{7{,}5} \tag{2}$$

The constant 7.5 is the calibration factor constant according to the sensor datasheet. The total volume of water in seconds can be written in equation 3 and 4.

$$Vt = \frac{Q}{60} \tag{3}$$

$$VT = Vt1 + Vt2 + Vt3 + \cdots Vtn \tag{4}$$

Q = water discharge (L/s)
Vt = volume of water (L/s)
VT = total volume of water (L/s)

The following is table 1, which contains spsification of the YF-S201 as water level sensor

Table 1 Spesification of YF-S201

YF-S201	**Spesification**
Operating Voltage	4.5V to 18V DC
Output type	5V TTL
Maximum current draw	15mA at 5V
The sensor used	Hall Effect
Working Flow rate	1 to 30 Liters/Minute
Accuracy	±10%
Pulses per Liter	450
Output duty cycle	50% +-10%
Maximum water pressure	2.0 MPa
Flow rate pulse characteristics	Frequency (Hz) = 7.5 * Flow rate (L/min)

C. Tools and materials

The following is table 2, which contains the tools and materials used for testing on this tool.

Table 2 Tools and Materials

No	**Tools and Material**	**Utility**
1	Water	Object research
2	ESP32	Data processing
3	Sensor *water flow*	Measuring water discharge, total water consumption and price
4	LCD 20x4 I2C	Displays the calculation results of water discharge, total water consumption, and price
5	RTC DS3231	Time reading
6	Laptop/PC	*Workstastion* for programming tools
7	Arduino IDE	Software used for writing, compiling & uploading code

D. Block Diagram

The block diagram of the system in this study can be seen in Figure 2 following :

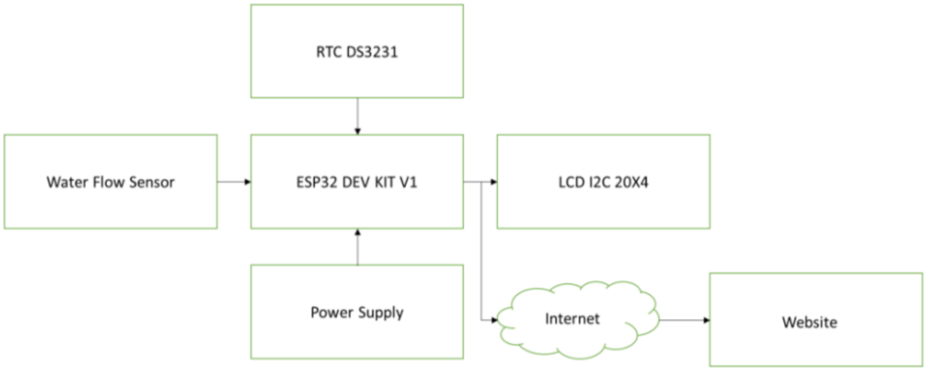

Fig 2. Block Diagram

The system design uses the nodeMCU ESP8266 microcontroller as the data processing. Sensors used for monitoring home water consumption stairs, namely water flow sensors. The sensor reading results are displayed on the 20x4 LCD I2C and blynk application on android smartphone. There is a DS3231 RTC module for reset the data on the total volume of water and the total cost of water once a month.

E. Flowchart

A flow chart or commonly referred to as a flowchart, is a type of diagram that displays a process or steps in the form of graphic symbols, and each sequence is connected by arrows. This flow chart is an illustration of solving a problem. The flow chart used in the research can be seen in Figure 3.

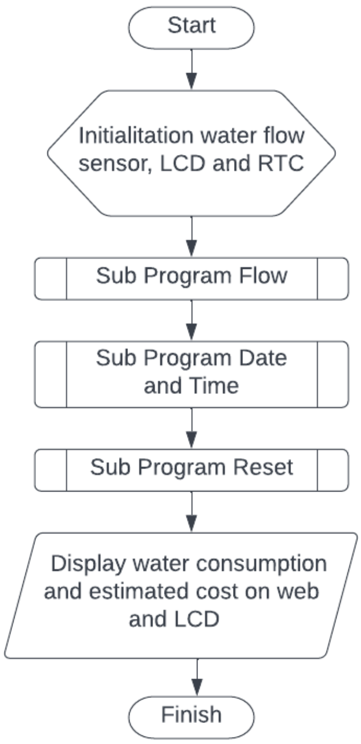

Fig 3. Flow chart

Stages starting with the initialization of the water flow sensor, RTC DS3231 and LCD 20x4 I2C. After the initialization stage is continued then with the flow sub program, sub-program date and time program and reset sub program. The results of data processing in the form of water level (L/M), water consumption (L), price, date and time displayed on 20x4 LCD I2C. The blynk application only displays water discharge, water consumption and prices.

Stages starting with the initialization of the water flow sensor, RTC DS3231 and LCD 20x4 I2C. After the initialization stage is complete then proceed with the flow sub program, sub-program date and time program and reset sub program. The results of data processing in the form of water level (L/M), water consumption (L), price, date and time displayed on 20x4 LCD I2C. The blynk application only displays water discharge, water consumption and prices.

The time reading from the RTC DS3231 module is in the form of date, month and year and hours, minutes and seconds. The time reading will later be displayed on 20x4 I2C LCD and useful for triggering on program reset.

RESULT AND DISCUSSIONS

In this research, a prototype is used as shown in Figure 4 for the front view and in Figure 5 for the side view. This prototype is connected to 3 water flow sensors which each measure the flow in each tap as shown in Figure 6.

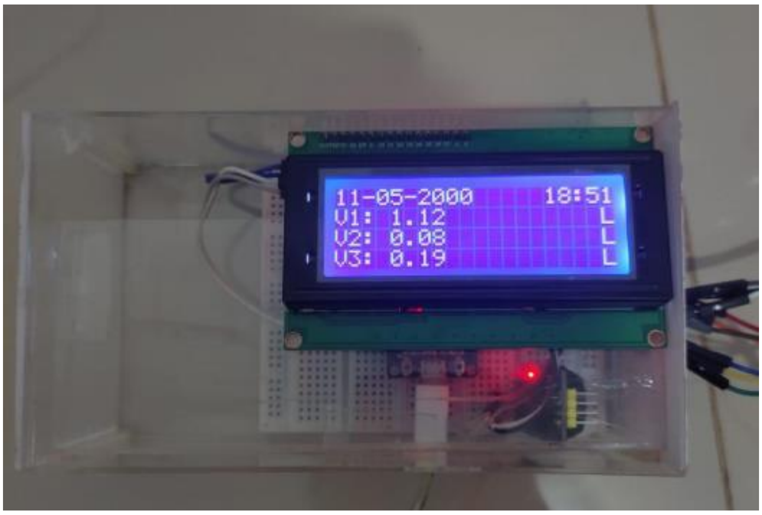

Fig 4. The Front view of the prototype

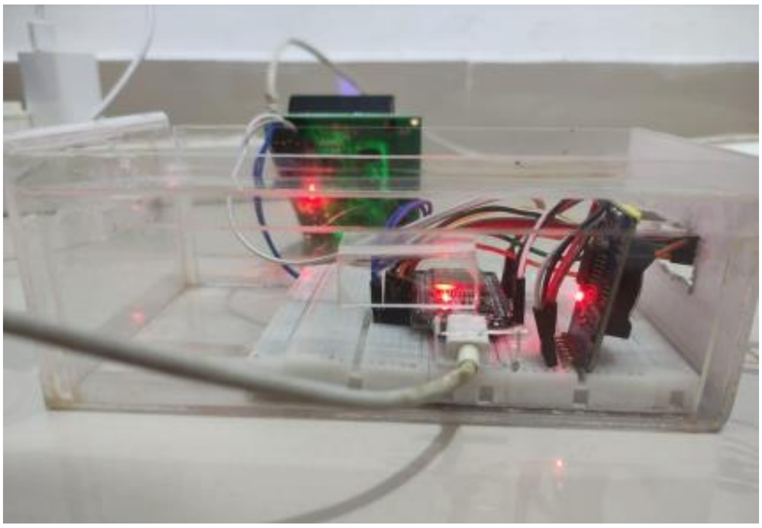

Fig 5. The side view of the prototype

A. Volume and Debit

Table 1. Volume and Debit in 500 ml, 1000 ml, 1500 ml, and 2000 ml

No.	Volume	Frequency Pulse	Measured Volume	Pulse Frequency Measured	Debit (Liter/ Second)	Time	Error
1	500	225	589	267	49.08	12s	17,80
2	500	225	582	258	48.5	12s	16,40
3	500	225	571	252	51.9	11s	14,20
4	1000	450	1065	486	59.16	18s	6,50
5	1000	450	1058	483	62.23	17s	5,80
6	1000	450	1043	508	61.35	17s	4,30
7	1500	900	1544	486	67.13	23s	2,93
8	1500	900	1533	483	69.68	22s	2,20
9	1500	900	1532	508	66.6	23s	2,13
10	2000	900	2008	942	69.24	29s	0,40
11	2000	900	2010	932	69.93	29s	0,50
12	2000	900	2014	940	71.92	28s	0,70
The Average Error							6,16

Data were taken in volume variations of 500 ml, 1000 ml, 1500 ml, 2000 ml, 2500 ml, and 3000 ml for each sensor as shown in Table 3.

$$Error\ (\%) = \frac{Measuremed\ Volume - Volume}{Volume} \times \%100 \tag{5}$$

From that equation, we can get the average of the error using this system. The average error is 6.16 %. The bigger volume, will make the error value decreased.

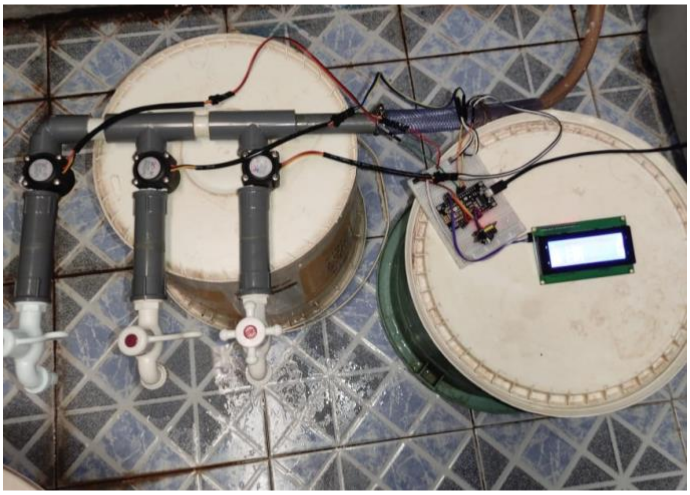

Fig 1. The taps and their water flow sensors

Water flow sensor testing is done using running water to find out whether the sensor system can work properly as we can see on Figure 6.

In displaying the water consumption management data, we also designed a website so that monitoring can be carried out based on IoT as shown in Figure 7. In Figure 8, the webserver sensor reading display is shown, we can get the information about the debit, monthly consumption, and cost estimation.

Fig 2. Homepage of The Website

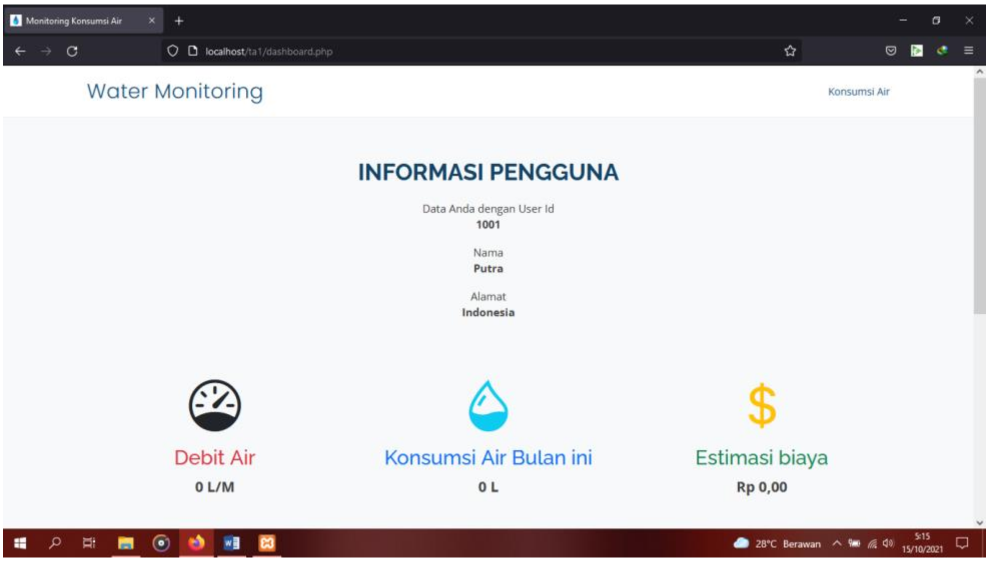

Fig 3. The Information System on Website

CONCLUSIONS

Based on this research, the following conclusions were obtained: Successfully implemented IoT based home water monitoring using Arduino. Successfully designed a tool for water tank management based on Arduino Uno. The results obtained by the tool can detect when the water is full, and the water pump turns off automatically so that the water does not fill again and the tank will not be full. The average error of this system is 6.16 % and the bigger volume will make the error value decrease.

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