Web Based Real Time Water Pressure Monitoring System

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Abstract— Nowadays, researches on real-time monitoring system have developed greatly. This research is intended to develop a real-time water pressure monitoring system on water distribution networks. Pressure monitoring is very important in assuring the availability of water supply to the community. Therefore, it is reasonable to develop a web-based real-time water monitoring system which is more efficient and easier to use.
This system utilized MPX5700AP as sensor to measure water pressure and Arduino UNO as system's performance control center with GSM/GPRS Shield application enabling the system to communicate with the server through GSM/GPRS network. This system was designed by applying C Arduino, HTML, PHP, and SQL as programming languages.
Result of the evaluations indicated system prototype operated well. System was able to measure water pressure and displaying graphics and data of the measurement on the webpage.

Keywords: *Water pressure monitoring, MPX5700AP sensor, Arduino UNO, GSM/GPRS Shield, Web Based*

I. INTRODUCTION

Water has become a vital need for the community. Governments through Regional Waterworks Company have concerned about this need and attempted to fulfill this need by providing water distribution pipe networks, an important part to deliver water to the community. The main function of distribution pipe networks is to deliver water to the community by paying attention on water quality, quantity, and pressure.

Water pressure in an area determines the quantity of water delivered to the community. Based on this reason, water pressure needs to be observed frequently. All this time, Regional Waterworks Company as representation of the government in distributing water to the community still relies on manual system by measuring water pressure on observation points. Therefore, a new easier and more efficient monitoring system needs to be developed. By applying Internet-based monitoring system, all information can be accessed wherever and whenever as long as there is Internet connection.

In monitoring a particular system, a measurement device is needed. Water pressure measurement device (manometer) needs to be monitored directly. Hence, the application of sensor is very efficient in monitoring this device.

II. RELATED WORK

In accordance with the development of computerized technology and the internet. Today web-based real-time monitoring system growing rapidly. Many research has been carried out like research about real-time monitoring of the new architecture using SVG and Comet for WEB design [1], the similar research is the development of a web-based decision support system that uses decision support system (DSS) to support resource management water in the area Degu, Korea [2]. As well as research on the use of Android-based sensor networks to collect rainfall data from various places and then displayed on a web [3]. The similar research on the use of GPRS technology, it can monitor and control the instrument with the cell phone. [4]

There is also the research about real-time monitoring system on the capacitive dielectric loss from equipment used, The data transmission using IEC61850 protocol [5]. While some research on monitoring system hydrological parameters in real time using wireless technology has also done [6]. As well as research on the development of real-time monitoring and remote sensing technology for the determination of water quality, so that would allow rapid detection and response in the event of a threat to the environment [7]

Based on the above, in this rersearch will be designed to build WEB based Real-time Water Pressure Monitoring System with technology GSM / GPRS. This system is expected to provide a database water pressure monitoring in real time which can be accessed through the website so that it has a wider area than the wireless network.

III. SYSTEM DEVELOPMENT

A. Hardware system

Real-time water monitoring system development consists of two stages: hardware development including microcontroller series and web development including website software development. The block diagram of this system is described in Figure 1.

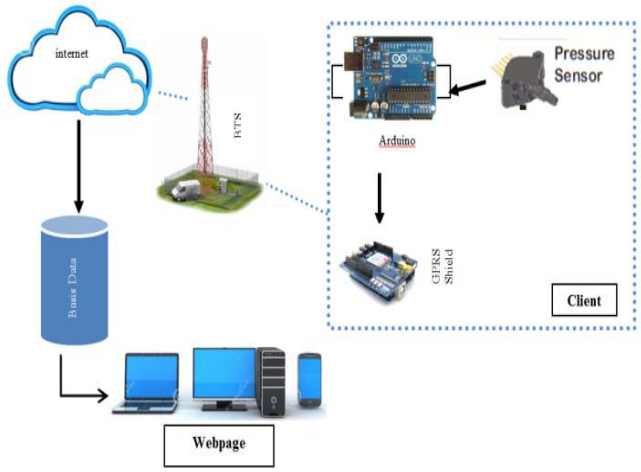

Fig 1. System Block Diagram

This system utilizes AVR ATMega 328 chip arranged on Arduino UNO microcontroller circuit board as microcontroller circuit. This system is equipped with PWM facility, serial communication, ADC, timer, interrupt, SPI, and 12C.

This circuit consists of two parts: input circuit comprising MPX5700 pressure sensor and output circuit comprising of GSM/GPRS Shield and LCD (Liquid Crystal Display). Microcontroller input and output circuit are described in Figure 2. In the input circuit using sensors type MPX5700AP to measure the water pressure amount. MPX5700 series has the ability to pressure 0 - 700 kpa or 0 - 101.5 psi, and produce output voltage analog 0.8 - 4.7 Vdc. This sensor combined with a microcontroller by linking one of the foot sensors that is pin 1 to pin A0 Arduino Uno (analog 0) while feet pin 2 is connected to ground and feet pin 3 is connected to VCC. The voltage that came out comparable with pressure that acquired. In the output circuit using LCD and GSM/GPRS Shield. LCD (Liquid Crystal Display) here working as display to water pressure as measured by the sensor. RS pin on the LCD that serves as the data input on the LCD is connected to pin 12 on the Arduino. In the first line of the LCD will display the indicator, while the second line displays the value of the magnitude of the pressure in units of kPa. There are 5 indicators displayed by the LCD include:

1. "Connecting." : Indicates that Arduino reading data water pressure
2. "STATUS= READY" : Indicates that GSM active and ready to work
3. "STATUS= ATTACHED" : indicates that the data has been transmitted to the database web
4. "STATUS= ERROR" : indicates that the data failed to be sent
5. "DONE" : indicates that the process has been completed delivery

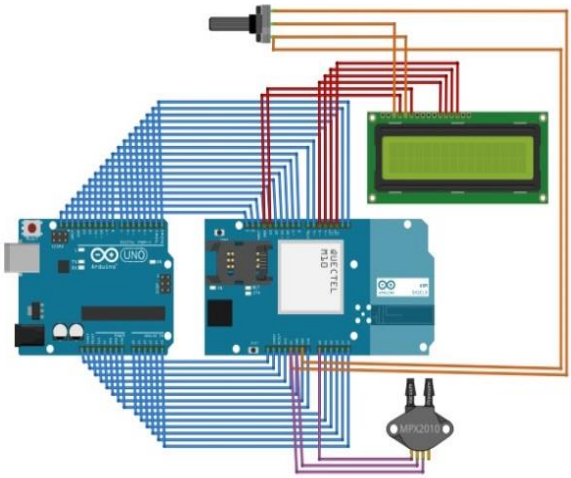

Fig 2. Microcontroller Input and Output Circuits

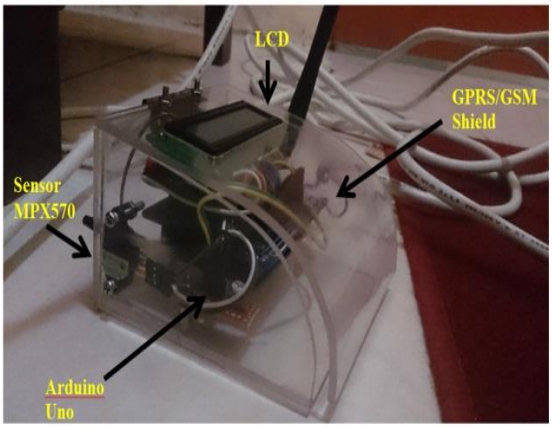

Fig 3.. Real-time Water Pressure Monitoring Device

Additional GSM/GPRS Shield device on Arduino circuit functions to send data and enabling Arduino to communicate with the server. This communication is in the form of data packets sent on certain intervals enabling the server to monitor water pressure data. Real time Water Pressure Monitoring device can see in figure 3.

B. Software System

1) Software Microcontroller

The microcontroller ATMega 328 used the software C-AVR programming language . Microcontroller software design aims to recognize and process the data sent by the input device and vice versa to send data to an output device. The flowchart program microcontroller can be seen in figure 4.

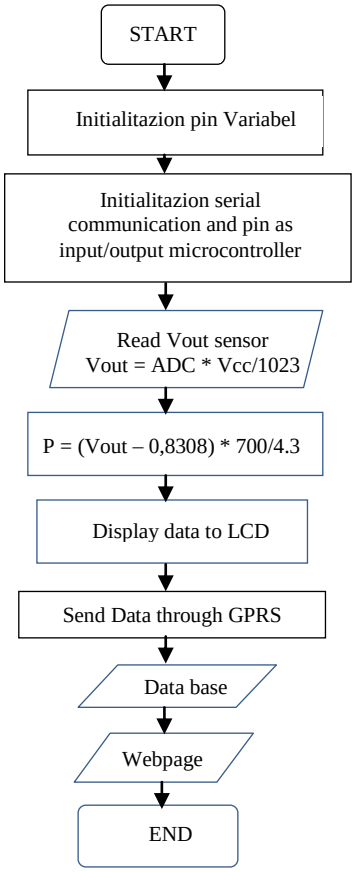

Fig 4. Flowchart of ATMega 328 Microcontroller Program

2) Software Website

There are some software that must be prepared before starting the programming for the web system monitoring, 1) Adobe Dreamweaver, Aptana Studio 3, Notepad ++ as a software for creating and designing web script; 2) 000webhost.com as a server; 3) PHP, HTML, CSS, Java Script and JQuery as a programming language; 4) MySQL for data storage.

Command lines are written and stored with the extension [*. Php] and [*. Html] uploaded on 000webhost.com directory that acts as a server, so that command lines that have been written can be compiled by Web server and web Browser. The web page is used as a container so that the user can interact with the server.

IV. Performance Evaluation

The following evaluations are conducted to assess the performance of the developed device.

A. MPX 57000 and LCD Evaluation

This evaluation is intended to examine the accuracy of data measured by the sensor and displayed on LCD compared to manometer measurement. The results of this evaluation are presented on Table 1.

From Table 1, we can see that the results of manometer measurement of water pressure are almost similar to measurement done by the sensor (as displayed on LCD). The highest error percentage of water pressure measurement is 2%. This result indicated that the accuracy of this system is pretty high.

B. Device Total Evaluation

Device total evaluation is done by examining whether the developed device was able to perform real-time water monitoring. This evaluation is done on waterworks pipes as sample for about 2 hours. Water pressure measurement results of 20 samples are presented in Table 2.

TABLE 1 THE COMPARISON OF MANOMETER AND SENSOR MEASUREMENTS

Manometer (kPa)	**Sensor (kPa)**	**Error Percentage (%)**
80	81	1.25
70	70.5	0.71
60	60.2	0.33
50	50.1	0.2
40	40.2	0.5
30	29.6	1.33
20	19.8	0.01
10	9.8	2

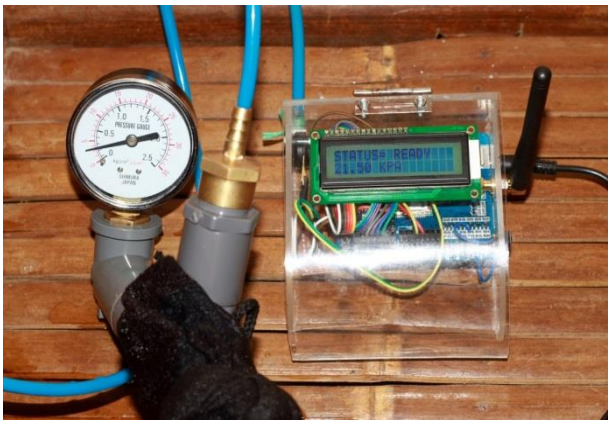

Fig 5. Device Total Evaluation

TABLE 2 RESULTS OF DEVICE TOTAL EVALUATION

Manometer (kPa)	LCD (kPa)	Web (kPa)	Send Data Time (s)	PK (%)
27	27	27	71	0
29	28	28	71	3.44
30	29	29	71	3.33
30	30	30	70	0
32	31	31	71	3.125
30	30	30	71	0
31	30	30	70	3.22
31	31	31	73	0
31	31	31	70	0
30	30	30	70	0
30	29	29	71	3.33
30	30	30	70	0
32	31	31	74	3.125
32	33	33	77	3.03
33	33	33	71	0
34	34	34	70	0
34	35	35	71	2.94
35	35	35	71	0
35	35	35	70	0
35	35	35	77	0

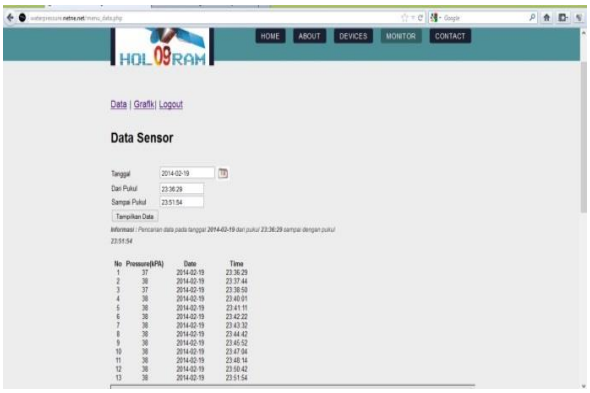

Fig 6. Measurement Data Layout (as displayed on the webpage)

Fig 7. Graphic Menu Layout (as displayed on the webpage)

The evaluation process is done by attaching the device onto waterworks pipe (sample) and parallelizing it with manometer. Device Total Evaluation can be seen in figure 5. Data read by MPX5700 sensor is sent to domain halamanreadData.php and stored in the database using script php command. Water pressure data and graphics are displayed on webpage http://www.waterpressure.netne.net. The display website and the graphic can be seen from the picture 6 and 7.

Based on data obtained from evaluation, it can be seen that the system operates optimally. The average error percentage of water pressure measurement by sensor is 1.27%. This result proves the difference between manual measurement and device measurement is very small. Therefore, this developed device can substitute manual measurement in estimating water pressure. However, time taken to send the data to the server depends on the quality of GSM network used.

V. CONCLUSION AND SUGGESTIONS FOR FURTHER RESEARCHS

This research was intended to develop web-based real-time monitoring system specialized in water pressure monitoring. From the evaluations which have been conducted, it is concluded that this system functioned perfectly and can be utilized to perform real-time water pressure monitoring.

This research applied GSM Shield on Arduino UNO enabling the device to perform data communication. GPRS enabled this device to perform distant communication because it utilized facilities provided by GSM service provider. GSM/GPRS Shield was able to send data as far as GSM provider signal coverage.

In order to perfect this system, further research should add some sensors to indicate pH, oxygen content, and water quantity. Therefore, the next monitoring systems developed are expected not only to be able to measure water pressure, but also to indicate the quality and quantity of the distributed water.

VI. REFERENCES

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