

The Integrated Water Quality Monitoring System Using Microcontroller

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Abstract—The quality of residential water has to conform the standard regulation of tap water. To meet the requirement, the water from the some sources is processed through several filtrations. In many places, the measurement processes are done in manual ways; thus the water could not be determined whether or not the water fulfills the quality standards in a real time manner. Therefore, in this paper we propose the integrated water quality monitoring system which is used to record the measurement data of Total Dissolved Solids, temperature and the acidity levels (pH) in water using sensors automatically. The microcontroller is used to convert the analog data to digital data. Then the data are transmitted wirelessly to the data center to be saved to the database system and represented by line chart. The monitoring system is successfully created using Java to display the multi-sources of remote systems.

Keywords —Total Dissolved Solids, tap water, monitoring system, water quality

I. INTRODUCTION

The quality of residential water has to conform to the standard regulation of tap water. The availability of tap water for the communities is related to the quality of the health of communities. The lack of good quality of tap water for communities becomes a problem which can lead to the health problems. Some Indonesian drinking water companies (i.e. PDAM) which are responsible for the availability of tap water in the remote area are still not using the optimal technology to manage the water processing. Currently many PDAMs managed many water sources without IT based. Some wheels are pumped and directly connected to the distribution pipes. If the raw water is pulled from the river, then some filtrations processing must be followed. Problem will arise whenever the quality of one source is out of standard. Since there is no or less monitoring activity, the quality of service to the community is questioned. Therefore the technology of water quality monitoring system should be implemented to monitor the condition of water retrieved from many sources of water. This kind of technology can be used to give early warning if the source of water is out of range and to record the data continuously.

In this paper we propose the integrated water quality monitoring system which can connect the instrument of measurement of Total Dissolved Solids, temperature and the acidity levels (pH) of the source water to the central data processor. The microcontroller is used to convert the analog data to digital data. The water quality monitoring system is installed in every of water sources. The retrieving data from the source of water in real-time are then transmitted to the data processing center using short message service. The data transmitted to the data center are saved to the database system and represented by line chart. The operator could monitor the TDS level, temperature level and pH level through the monitor display.

II. THE INTEGRATED WATER QUALITY MONITORING SYSTEM

The technique which utilizes the microcontroller ports as a rectangular wave generator in the manner of push-pull can be used to measure TDS. The model of utilizing the microcontroller ports is shown in the Fig.1. An electrical current flows from the port 1 to the port 2 through the water resistance (R) and vice versa. The electrical current value which flows from the port 1 is high while the electrical current value which flows from the port 2 is low [1].

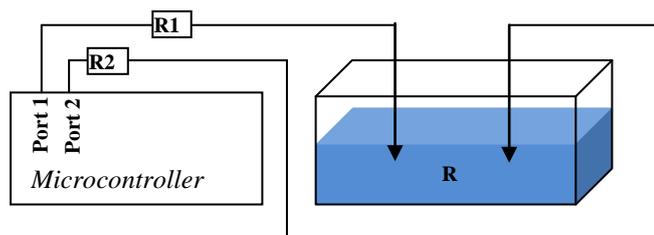


Fig. 1. The model of utilizing the microcontroller ports [1]

The pH sensor cannot be attached directly to the ADC since the output impedance of pH sensor is very high. The output of sensor is maintained and calibrated by using non-inverting amplifier and followed by the inverting amplifier to adjust the gain and slope. That output of amplifier is proportional to acidity level (pH). The output of pH and TDS are depended on temperature. So, the temperature sensor must be applied to give more accurate data.

The Fig.2 shows the design of the integrated water quality system which can be used to monitor the water sources in the remote area. In this system there are sensors which are used to retrieve the analog data of temperature level, acidity level and TDS level of water. The analog data obtained from the sensors are converted to the digital data by the microcontroller. The digital data are transmitted by microcontroller to the computer server through GSM modem. The data is formatted by certain codes:

***The location of water source *TDS*Temperature*pH# x number of calibration**

The following is the example of the data which is transmitted using short message service.

***JEBRES*1695*268*72#x10**

In the example above, the location of water source is in the district of JEBRES, in Solo City, in Indonesia. The TDS level of water is 169.5 ppm. The temperature of water is 26.8 Celsius. The pH level of water is 7.2.

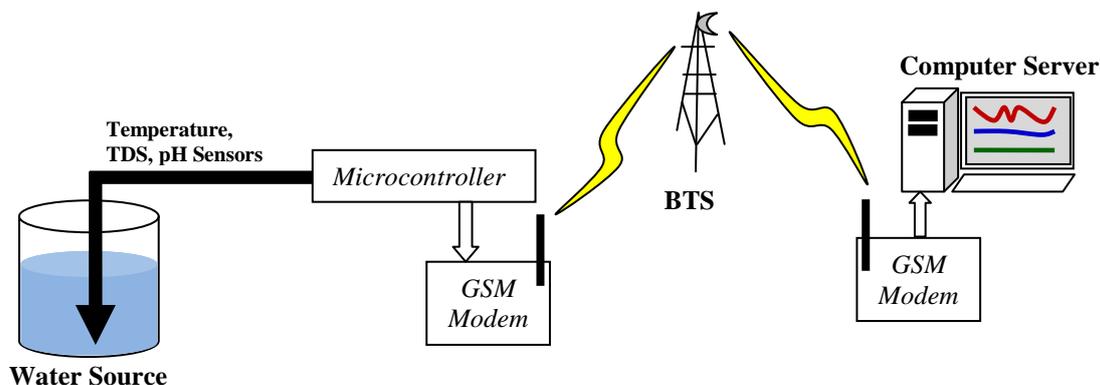


Fig. 2. The water quality monitoring system

In the computer server the information which is received from GSM modem are processed and saved into database system. The data of the temperature level, acidity level and TDS level are inserted to the database system table using Structured Query Language (SQL) [2]. The data are retrieved from database system using Java SQL and displayed in graphical form using Java Swing [3]. The operator could monitor the temperature level, acidity level and TDS level of water in the water sources in the district area.

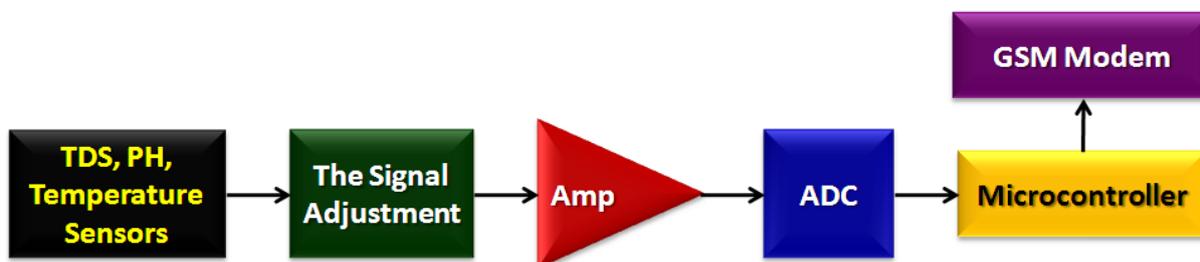


Fig. 3. The block diagram of the hardware of quality water monitoring system

The Fig.3 shows the block diagram of the hardware of quality water monitoring system which has been designed and realized to the schematic and printed circuit board layout. The hardware module has some inputs from sensors and the keyboard to change the parameters. This module also has an output of the 16x2 LCD character display. In every remote module, the signal conditioner, amplifier, microcontroller and GSM modem are connected as the schematic design.

The Fig.4a displays the remote system after the sensor is applied to the water and when the remote module is seen from the top. The analog signals from the sensors are passed to the amplifiers. The analog signals that have been amplified are converted to the digital signals using Analog to Digital Converter (ADC). Then the digital signals are transmitted to the computer server using GSM modem which is controlled by the microcontroller via AT-command. Modem Sim300C is attached here to support the SMS function.



Fig. 4. The remote system front (a) and top side (b).

The remote system is placed in every location of the water sources and managed by the host. The various data of TDS, temperature and pH level are transmitted from various locations of water sources to the host. The host computer server will display the data from various locations of water sources graphically. The use case diagram of the software of quality water monitoring system in computer server is shown in Fig.5.

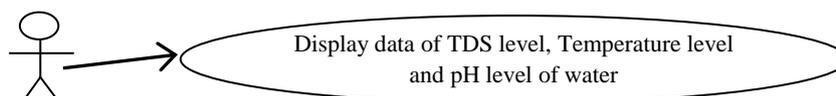


Fig. 5 the use case diagram of the software of quality water monitoring system.

The Fig. 5 shows the display of quality water monitoring system. The simulation data of TDS, temperature and pH level are retrieved from two example locations of water sources JEBRES and MOJOSONGO in Solo City, Indonesia.



Fig. 5. Displays the data from the remote system hardware

III. RESULTS

The two remote systems and one host system have been built as an example of the integration idea. The remote systems can display the current result to the LCD 16x2. Also they have successfully captured and transmitted the data to the host. On the host side, after receiving the data from the GSM, the data are parsed and saved into the DBMS via SQL-command. For specific interval of time, the data will be presented to update the chart.

IV. CONCLUSION

The integrated water quality monitoring system which is consisted of the hardware located in the water sources and software in computer server can be implemented successfully. The system is able to measure and display graphically the TDS, pH and temperature level of water from two water sources which are named for location in JEBRES and MOJOSONGO. This system can also be developed to support the service of national drinking water company to monitor the water quality of all over the country.

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