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Wireless Monitoring of the Operating Parameters of a Pressure Reducing Chamber using the Nemos N210 Datalogger

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***Abstract*—Many of the drinking water systems need to be permanently monitored to detect failures or disturbances in a timely manner; In this sense, this article describes a solution for the monitoring of pressure reducing chambers (PRC) through the integration of communication protocols GSM (Global System for Mobile Communications) and GPRS (General Packet Radio Service), through of the use of the NEMOS N210 datalogger. Initially, the system architecture, the components used and their implementation are described. The collection of data related to the operation of the PCR was carried out, these being the pressure, flow and volume. The results allow us to conclude that the implementation of this type of technology in the drinking water distribution system is viable, since the data that was transmitted wirelessly shows that the inlet pressure to the PCR is effectively regulated. While in the case of volume and flow values, the measured values were within the established values, reaching a value of 627,104.20 m3 for volume and 66,409 l/s for flow.**

***Keywords*—Wireless monitoring; Operation parameters; Pressure reducing chamber; Datalogger**

Introduction

Nowadays, drinking water supply companies require optimizing processes focused on technological advances in automation, supervision and control through industrial networks [1,2]; since these contribute to the improvement of the efficiency, quality and reliability of water distribution systems [3].

In some cases, not only improving their distribution, but they are also used to monitor water quality parameters [4-6]. However, in these times there are still countries in which the entire drinking water distribution system does not conform to technological progress [7]. The population increase in many countries requires optimizing the drinking water distribution process to avoid unexpected outages due to component failures [8].

Studies on drinking water systems turn out to be pertinent due to the importance of supplying the target population in an inefficient manner [9, 10], since water is an essential and indispensable service for human beings [11,12]. According to the United Nations Organization, even when 89% of the world population uses improved drinking water sources, there are still 783 million people who lack efficient service [13]. Likewise, according to the World Health Organization indicates that by 2025 half of the world's population will live in areas of scarce water, which means a problem to be taken into account seeking solutions through the use of technology [14, 15]. Within the problems that are generated in the drinking water system, it is often due to failures in the distribution network, supply cuts and the level of pumping pressure that is not optimal enough [16,17]. Thus, it is also often evident that the detection of failures is late, causing harm to the population and reducing the performance of the network due to water leaks [18].

In the 70s, the trend in automation was that each manufacturer had to solve their control and automation problems on their own, however, over the years, equipment from different manufacturers allows the integration of electronic devices, even when they work with different protocols [19]. One of the alternative solutions to supply problems due to failures in drinking water systems are automated monitoring systems, which guarantee permanent communication between the components of the process and the central station [20,21]. The importance of automation in the process industry has increased incredibly in recent years and has in fact contributed to the improvement of the operation of drinking water systems [22,23]. In this way, each subsystem can be controlled, reducing downtime, through the permanent monitoring of operating variables, such as pressure and flow, in order to evaluate its operation and apply corrective actions in a timely manner [24,25]. And it is that through the monitoring systems the reliability and safety of the operation of the drinking water systems is guaranteed, identifying the variability of parameters such as pressure and flow [26].

The alarm systems included in drinking water systems contribute positively to identify failures in real time, and accurately identify the failure in the drinking water system [27-29]. Supervision, monitoring and control systems that allow alarm management control the different variables remotely through communication systems based on communication protocols Profibus, Profinet, Modbus among others [30-32]. An industrial monitoring network with constant data capture capacity allows recording and storing the status of different variables, ensuring that information is permanently available and easily accessible [33,34]. In relation to industrial monitoring networks, wireless technologies have adopted over time a simpler and more comfortable way to use all kinds of devices in order to improve the use and communications in various standards and protocols [35].

In this sense, this article aims to describe a solution for monitoring pressure reducing chambers (PRC) through the integration between communication protocols GSM-GPRS, through the use of the NEMOS N210 datalogger. Initially, the system architecture, the components used, and their implementation are described. To then show the analysis of the results collected regarding the behavior of the operating parameters such as pressure and flow of the drinking water distribution system.

Literature Review

Medrano [36], develops a remote management system for drinking water hydraulic networks, in which he points out that one of the aspects that frequently causes failures in these types of systems is the lack of monitoring of indicators such as pressure and flow, in such a way that it allows to act in time at the moment of any modification of the range of operation of these parameters.

Romero [37], describes the technological applications for the digitization of the urban water cycle, in which he specifies that the digital tools linked to remote management contribute to the monitoring of field parameters such as pressure, flow, equipment operation, all as part of an automated system that provides information in real time.

Chambi and Jauregui [38], describe the design of a drinking water consumption monitoring system applying telemetry through technologies based on microcontrollers, with which they managed to obtain the measurement of various parameters of a water network, thus demonstrating the feasibility of your design. Velaña [39], develops the design of a telemetric prototype for drinking water systems, in which it is formulated as one of the research problems, if it is possible to implement an adequate control technology to monitor the drinking water system, therefore which concludes that it was possible using SSH (Secure Shell) and GSM/GPRS (Global System for Mobile Communications/General Packet Radio Service) communication protocols, since this offer reliability of the data collected at low cost. Manrique and Atalaya [40], describe a wireless monitoring system for drinking water stations in which they used programmable logic controllers interconnected through microwave radio links, twisted pair and fiber optics, in which the factors of the communication system are concluded. They intervene, to a large extent, in the quality parameters of the monitoring system, this because they guarantee reliable communication between the drinking water stations. In this regard, Alaéz [41] points out that referring to smart cities implies that the city's public services rely on technological communication tools to monitor the management, for example, of the drinking water system, for which its application in the search for provide a good service to the inhabitants.

Methodology

Research design

The research design is non-experimental of a longitudinal type, since the data is collected and processed in its natural state, since no control is exercised over the monitored variables. Thus, it is also established that it is of a longitudinal type because the data on the inlet and outlet pressure of water were collected for a month, every one minute, while the volume and flow rate were also collected every five minutes for a month.

Research level

The level of investigation is of a descriptive type, because initially it seeks to establish if the measured results comply with being within the levels established as optimal for the indicators under analysis such as pressure, volume and flow. Thus, it is also established that the research reaches a relational level, since it seeks to establish the validity of the results through the correlation analysis between the operability parameters.

Data collection and analysis unit

The unit of analysis is the pressure reducing chamber called Heraud, located in the district of Barranco, city of Lima in Peru. On which data will be collected through the extraction of data monitored by the Nemos N210 datalogger, during a continuous period of one month, from June 25, 2022 to July 25, 2022.

DESCRIPTIONAND DEVELOPMENT

Description of the monitoring system

The architecture of the wireless system for monitoring the operating parameters of the pressure reducing chamber makes use of a Nemos N210 datalogger, which is capable of recording analog signals in the range of 4 to 20 mA and digital signals by means of pulses. This recorder was installed in the “pressure reducing chamber called Heraud located in the district of Barranco, city of Lima, in Peru. This datalogger will record the data linked to the operating indicators of the pressure reducing chamber, these indicators being the volume, inlet pressure, outlet pressure and flow.The data acquired will be sent to interlocutors, either to the monitoring and control supervision center or to the Zeus Azure server, for storage through structured tables, thus managing to process them in real time to obtain information that leads to decision making. Figure 1 shows the communication architecture of the Nemos N210 data logger with the Pressure Reducing Chamber. It should be noted that the drinking water distribution system is made up of pressure reducing chambers, wells, reservoirs, and inlet chambers, without However, the study is limited to the monitoring network of the pressure reducing chambers, since these are the end points for the distribution of water to household intakes, which is why they become the most critical elements in the system distribution.

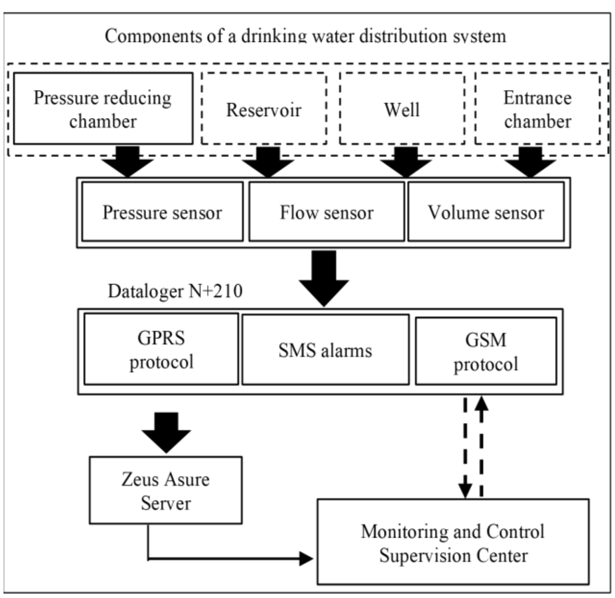

Figure1 Communication Architecture Of The Nemos N210 Datalogger With The Pressure Reducing Chamber

Table I shows the technical characteristics of the Nemos N210 datalogger, which will be linked to the pressure reducing chamber through flow, volume and pressure sensors.

TABLE I
CHARACTERISTICS OF THE NEMOS N210 DATALOGGER

Characteristic	Details
Electricalpowersupply	Pack litio 7.2 v 14 AH o 28 AH
IP grade	IP68
Operatingtemperature	-20 °C a 75 °C
Antenna	Dipolo ½λ
GSM modem	U-Blox 3G
Real time clock	High accuracy ±2ppm
Setting	Bluetooth 4.4

It should be noted that the data logger has two analog inputs with 16-bit resolution and 0.1% precision. Also, with respect to its output, it has two outputs whose precision is 5%, with a current value of 0 to 20mA. Regarding its pressure probe, the datalogger presents two probes with a measurement range of 0 to 20 bar, with a precision of 0.40%, and Modbus RTU field bus over RS-485. Figure 2 shows the front view of the Nemos N210 datalogger, which will be integrated into the pressure reducing chamber and the supervision and control center through wireless communication protocols.

Figure 2 Datalogger NEMOS N210

The system to be developed has the capacity to communicate with the supervision, control and data acquisition system since it also handles the OPC (OLE for Process Control) protocol. Therefore, it allows the generation of a remote management network, since the monitoring system presents a group of electronic equipment, which is in charge of controlling the different field elements through electrical signals or also through communication systems that provide facilities for measurement and monitoring.

The system described also uses cyclic timers, in order to establish the period of data capture by the datalogger.

Based on what has been indicated, the data of the pressure variable, both inlet and outlet, have been configured to register every minute and the volume with flow rate every five minutes. In the weekly timer's option, we will indicate 06:05 and 22:05, so that it is the time to send data to the Zeus Assure cloud.

Figure 3 shows the connection circuit of the inputs and outputs of the Nemos N210 datalogger with the pressure reducing chamber under observation, which shows the red probes that are considered to measure the pressure of inlet and outlet water pressure. So also, the other two connections correspond to the flow and volume sensors.

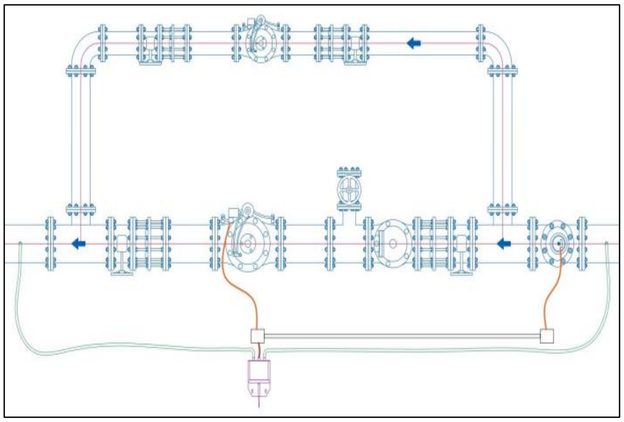

Figure 3 Connection Circuit Of The Inputs And Outputs Of The NEMOS N210 Datalogger With THE PCR

Development of the monitoring system

The installation of the equipment was done in 3 main structures of the drinking water distribution network, these being the valve boxes located inside the pressure reducing chambers, in which the input and output probes of the N210 datalogger were integrated. On the other hand, for the purposes of establishing the monitoring of indicators in all the components of the drinking water distribution system, we proceeded to connect flow and volume sensors model MAG800 of the Siemens brand in the storage tanks and in the wells Water.

With the purpose of proceeding with the installation and programming of the equipment, we proceeded to install hydrotomes in the pipes as well as the transducers incorporated into the Nemos N210 datalogger monitoring equipment, in order to capture data on the inlet pressure and outlet, also as already mentioned that the installation of the equipment was carried out in three main structures of the network, for which external pressure sensors were used since it was also relevant to capture flow and pressure data at those points. Based on this need for the number of inputs and outputs, the type of datalogger to be used was defined.

Figure 4 Integration Of The NEMOS N210 Datalogger With The Pressure Reducing Chamber

Under what is indicated in Figure 4, the implementation carried out in the pressure reducing chamber is shown, in which the connection of the Nemos N210 datalogger is evidenced, whose half-wavelength dipole antenna will allow interconnection with the central station supervision and control through the communication protocol GSM/GPRS at 9,600 Bauds. The connection of the datalogger probes that were interconnected to the inputs and outputs of the pressure regulating valve is also displayed.

Another aspect that was also part of the implementation stage is the datalogger configuration stage, for which the MicroConf software was used, in which, as shown in Figure 5, we proceeded with the configuration of the parameter to be monitored, its sample capture time, as well as alarms, timers and notification mode (SMS).

Figure 5 Configuration Of The NEMOS N210 Datalogger

Additionally, the system of supervision, control and data acquisition (SCADA) was developed, which manages to receive and store information provided by the Datalogger N210. Based on what was indicated, the programming and configuration of the controller was carried out, so that as a first stage the name of the variables for programming was defined. Table II details the name assigned to each variable as well as the purpose of the definition in the SCADA system.

TABLA II
VARIABLES GROUPED BY PURPOSE IN THE SCADA SYSTEM

Variable name	Purpose of defining variables in programming
Input_PressureNorm_Presu_InScal_Presu_In	These variables are defined for the detection, normalization and scaling of the “inlet pressure sensor” signal.
out_Pressure Norm_Presu_Out Scal_Presu_Out	These variables are defined for the detection, normalization and scaling of the signal of the "outlet pressure sensor".
flow_ sensor Norm_flowScal_flow	These variables are defined for the detection, normalization and scaling of the "flow sensor" signal.
Vol_sensorNorm_vol Scal_vol	These variables are defined for the detection, normalization and scaling of the "volume sensor" signal.

Another aspect to specify is what is shown in Table III, which specifies the type of variable, the address it will occupy in the controller's memory and its corresponding.

Table III
Variables Defined In The Programming Of The Scada System

Name	Types	Direction
Input_Pressure	Word	%IW64
Out_Pressure	Word	%IW66
Vol_ sensor	Word	%IW96
Flow_sensor	Word	%IW98
Norm_Presu_In	Real	%MD0
Scal_Presu_In	Real	%MD4
Norm_Pressure_Out	Real	%MD8
Scal_Pressure_Out	Real	%MD12
Norm_vol	Real	%MD16
Scal_vol	Real	%MD20
Norm_flow	Real	%MD24
Scal_flow	Real	%MD28

Once the variables of the PLC-S71200 have already been mentioned, the first thing to do is programming the two pressure sensors, the first is the input pressure sensor (%IW64), it is a sensor that works with 4-20 mA; In this regard, Melgarejo-Jara et al. (2023) [42] points out that the PLC will recognize it with a digitization of 0-27,648 (that is, 0 is 4mA, and 27,648 is equivalent to 24 mA).The output of NORM_X is given by a real mark (%MD0) that is the result of the input of the inlet pressure sensor (%IW64) through NORM_X.Then the Norm_Presu_In marker (%MD0) is connected to the SCALE_X command which will be evaluated with the ranges from 0 to 204 MCA described in the article, the output of the SCALE_X identified with the real mark (%MD4) is the output of the pressure sensor input that will be used to display the values in the SCADA.The second is the output pressure sensor (% IW66) it is a sensor that works with 4-20 mA, which the PLC will recognize with a digitization of 0-27,648 (that is, 0 is 4mA, and 27,648 is equivalent to 24 mA).The output of NORM_X is given by a real mark (%MD8) which is the result of the output pressure sensor input (%IW66) through NORM_X.Then the Norm_Presu_Out marker (%MD8) is connected to the SCALE_X command which will be evaluated with the ranges from 0 to 204 MCA described in the article, the output of the SCALE_X identified with the real mark (%MD12) is the output of the pressure sensor output that will be used to display the values in the SCADA.Figure6 shows the programming of the two pressure sensors (both inlet and outlet).

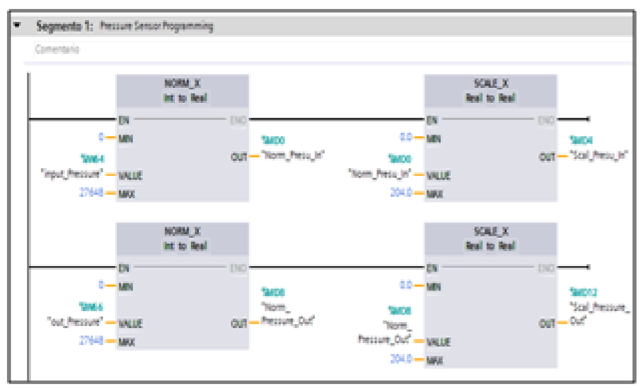

Figure 6 Programming Of The Two Pressure Sensors (The Inlet And The Outlet).

Figure 7 shows the programming of the flow sensor (%IW98), as it is a sensor that works with 4-20 mA, the PLC recognizes it with a digitization of 0-27648 (that is, 0 is 4mA, and 27648 is equivalent to at 24mA). The output of NORM_X is given by a real mark (%MD24) which is the result of the input of the inlet pressure sensor (%IW98) through NORM_X.Then the Norm_flow marker (%MD24) is connected to the SCALE_X command which will be evaluated with the ranges from 0 to 100 L/s described in the article, the output of the SCALE_X identified with the real mark (%MD28) is the output of the sensor inlet pressure that will be used to display the values in the SCADA.

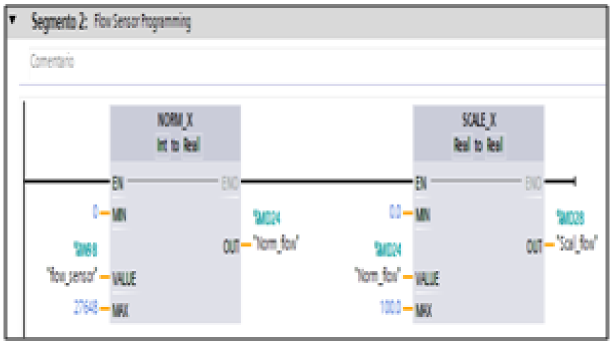

Figure 7 Programming The Flow Sensor

Finally, the volume sensor (% IW96) was programmed. It is a sensor that works from 4-20 mA, which the PLC will recognize with a digitization of 0-27,648 (that is, 0 is 4mA, and 27,648 is equivalent to 24 mA). The output of NORM_X is given by a real mark (%MD16) which is the result of the input of the inlet pressure sensor (%IW96) through NORM_X.Then the Norm_vol marker (%MD16) is connected to the SCALE_X command which will be evaluated with the ranges from 0 to 1000 m3 described in the article, the output of the SCALE_X identified with the real mark (%MD20) is the output of the pressure sensor input that will be used to display the values in the SCADA.Programming the volume sensor is shown in Figure8.

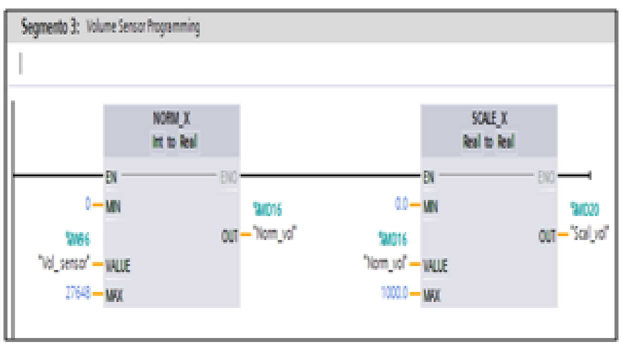

Figure 8 Volume Sensor Programming

RESULTS AND DISCUSSION

Table IV shows a segment of the 43,568 data collected during a month, through the wireless monitoring system applied to the pressure reducing chamber using the Datalogger Nemos N210, in which the data capture corresponding to the operating parameters such as inlet pressure, outlet pressure, volume and flow. It should be noted that the inlet and outlet pressure units are expressed in MCA (Meters of Water Column), the volume in cubic meters (m^3) and the flow in Liters per second (L/s).

TABLE IV
SEGMENT OF DATA COLLECTED

Inlet pressure	Outlet pressure	Volume	Flow
43.470	31.699	627,147.00	84.242
43.715	31.699	627,147.00	84.242
43.959	31.455	627,147.00	84.242
43.715	31.699	627,147.00	84.242
43.470	30.724	627,147.00	84.242
43.959	22.189	627,122.00	63.973
44.203	21.702	627,122.00	63.973
44.203	21.946	627,122.00	63.973
44.203	22.189	627,122.00	63.973
44.203	21.946	627,122.00	63.973
44.447	21.946	627,103.00	62.876
44.203	22.189	627,103.00	62.876
44.203	22.189	627,103.00	62.876
44.203	21.946	627,103.00	62.876
44.203	22.189	627,103.00	62.876
43.959	21.946	627,084.00	61.29
43.959	21.458	627,084.00	61.29
44.203	20.700	627,084.00	61.29
44.203	21.214	627,084.00	61.29
44.447	21.214	627,084.00	61.29
43.959	21.458	627,065.00	59.664
44.203	21.458	627,065.00	59.664
44.203	21.458	627,065.00	59.664
44.203	21.458	627,065.00	59.664
43.959	21.458	627,065.00	59.664

For purposes of being able to carry out an analysis of the collected data, it is important to specify that the optimal levels established for each of the system performance parameters are shown in Table V.

TABLE V
OPTIMUM LEVELS OF THE PERFORMANCE PARAMETERS OF THE WATER DISTRIBUTION SYSTEM

Performance parameters	Minimumvalue	Maximumvalue
Inlet pressure	32.946 MCA	44.500 MCA
Outlet pressure	16.556 MCA	34.625 MCA
Volume	415,557.00 m^3	628,147.00 m^3
Flow	51.145 L/s	107.376 L/s

Another aspect to highlight is the data collected in the SCADA system from the N210 datalogger.

Figure10 shows the monitoring test of the pressure reducing chamber, that when the system is turned on, the water pressure enters the pressure reducing chamber where the pressure sensor (% IW64) marks 43.4 MCA, then in at the outlet of the first "T" pipe the volume sensor (%IW96) marks a value of 627.1 m3 of water, at the outlet of the second "T" pipe the flow sensor (%IW98) marks a value of 84.2 L/s of water and with an outlet pressure (% IW66) of 31.6 MCA.

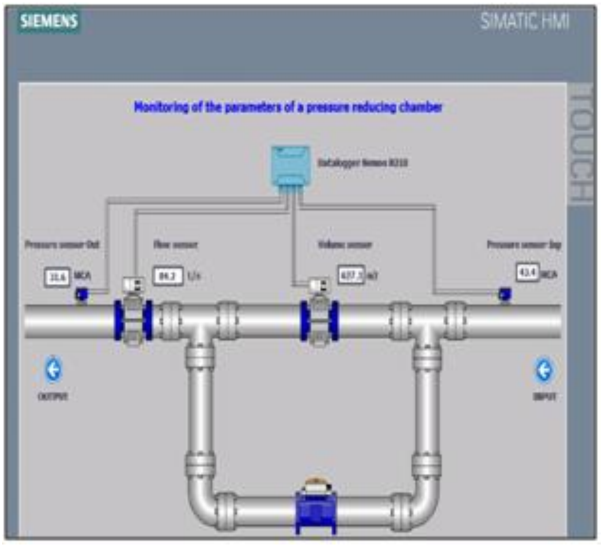

Figure 10 First Case Of Monitoring The Pressure Reducing Chamber.

Figure 11 shows the second case of monitoring the pressure reducing chamber, here the water pressure enters the pressure reducing chamber where the pressure sensor (% IW64) marks 44.2 MCA, then at the outlet of the first “T” the volume sensor (%IW96) marks a value of 627.1 m3 of water, at the outlet of the second “T” the flow sensor (%IW98) marks a value of 63.9 L/s of water and with outlet pressure (%IW66) of 21.9 MCA.

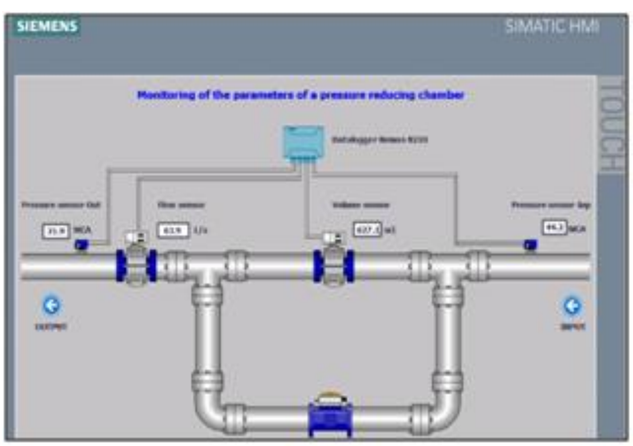

Figure 11 Second Case Of Monitoring The Pressure Reducing Chamber.

Figure12 shows the third case of monitoring the pressure reducing chamber, in this case the water pressure enters the pressure reducing chamber where the pressure sensor (%IW64) marks 44.4 MCA, then at the outlet of the first “T” the volume sensor (%IW96) marks a value of 627.0 m3 of water, at the outlet of the second “T” the flow sensor (%IW98) marks a value of 61.2 L/s of water and with an outlet pressure (%IW66) of 21.2 MCA.

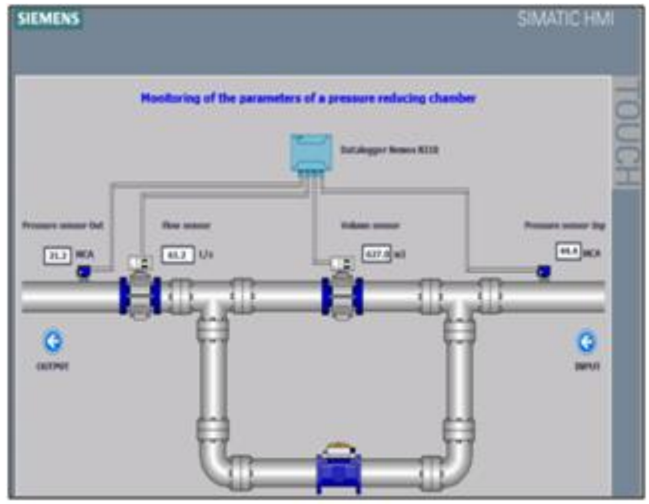

Figure 12 Third Case Of Monitoring The Pressure Reducing Chamber.

Based on these data and in order to establish the relationship between the monitored parameters, Table VI shows the level of correlation between the inlet pressure of the PRC and the volume measured in the monitored drinking water distribution system wirelessly through the Nemos N210 datalogger. As can be seen, there is an inverse and moderate relationship between both operating parameters, this is due to the fact that the Pearson correlation coefficient turned out to be equal to -0.535.

TABLE VI
CORRELATION BETWEEN INLET PRESSURE AND VOLUME

		Inlet pressure	**Volume**
Inlet pressure	Pearson correlation	1	-0.535
Volume	Pearson correlation	-0.535	1

Table VII shows the result of the correlation made between the inlet pressure and the flow in the drinking water distribution system, in which it was possible to determine that there is an inverse and high relationship between both operating parameters. In this case, the Pearson correlation coefficient turned out to be equal to -0.773.

TABLE VII
CORRELATION BETWEEN INLET PRESSURE AND FLOW

		Inlet pressure	Flow
Inlet pressure	Pearson correlation	1	-0.773
Flow	Pearson correlation	-0.773	1

Table VIII shows the results of the correlation between the pressure measured at the exit of the PCR and the volume, in which it was possible to determine that there is a direct and high relationship between both operating parameters. In this case, the Pearson correlation coefficient turned out to be equal to 0.784.

TABLEVIII
CORRELATION BETWEEN OUTLET PRESSURE AND VOLUME

		Outlet pressure	Volume
Outlet pressure	Pearson correlation	1	0.784
Volume	Pearson correlation	0.784	1

Table IX shows the results of the Table VII shows the results of the correlation between the pressure measured at the exit of the PCR and the flow rate, in which it was possible to determine that there is a direct and high relationship between both parameters of operation. In this case, the Pearson correlation coefficient turned out to be equal to 0.992.

TABLE IX
CORRELATION BETWEEN OUTLET PRESSURE AND FLOW

		Outlet pressure	Flow
Outlet pressure	Pearson correlation	1	0.992
Flow	Pearson correlation	0.992	1

As evidenced through the results, it was feasible to implement the wireless monitoring system of the pressure reducing chamber through the Nemos N210 Datalogger, under the transmission of data through GSM/GPRS communication protocols, with which managed to detect failures in time through the use of alarms, thus an incident record was also generated, which made it possible to identify high-risk components, in order to apply preventive maintenance and avoid the shortage of drinking water to the population to whom provides you with the service.

In this regard, Medrano [36], points out that the monitoring system implemented to develop remote management of drinking water hydraulic networks, was supported by GSM technology, which allowed the transmission of data such as pressure, volume, which allowed them to Within their expectations, it is possible to monitor the volume of water delivered and consumed, identify areas with a high rate of leaks and areas of optimal supply with which it is evident that the use of technologies that are supported by GSM protocols turn out to be viable for applications of transmission and reception of data from drinking water stations, which supports the solution proposed in this investigation. Likewise, Romero [37], concludes that the general implementation of the different wireless technologies allows the transformation of the way in which they monitor the processes linked to the drinking water service, managing to optimize and offer a better service in the integral cycle of Water. Another work that is also in line with the objective achieved in this research is the one developed by Chambi and Jauregui [38], who conclude that having an automated measurement system allows readings from various meters to be collected, making this process efficient, and transmitting to any terminal including cell phones through text messages.

Continuing with the viability of the GSM/GPRS technology used in this research, Velaña [39] points out that the SSH and GSM communication protocols are competitive technologies that offer data reliability and that their use also turns out to be convenient due to their costs, and why they work in mobile phone bands which guarantee data transmission in a greater range of coverage. Likewise, focusing on the benefits generated by this type of monitoring in this regard, Alaéz [42] concludes that using remote management in drinking water services guarantees improvements in the operability and functioning of the distribution network, identifying possible animals or failures in the network in time in a timely manner, which today are important factors to migrate to what is called smart cities.

CONCLUSIONS

In relation to the objectives set out in this investigation, it is concluded that it was possible to demonstrate the feasibility of monitoring the operating parameters of the pressure reducing chamber through the Nemos N210 datalogger, this through the use of GSM-GPRS communication protocols, the same that manages to transmit data measured in real time of the inlet pressure, outlet pressure, flow and volume. Regarding the measured values of the operability parameters, these were found within the minimum and maximum set point values established to guarantee the operability and operation of the distribution system.

In addition, it is concluded that the values transmitted by the datalogger exist an inverse and moderate relationship between the inlet pressure of the PRC and the volume, this because the Pearson correlation coefficient turned out to be equal to -0.535. Thus, it was also determined that there is an inverse and high relationship between the inlet pressure and the flow, with a Pearson correlation coefficient equal to -0.773. In addition, with respect to the pressure measured at the exit of the PCR, it is directly and highly related to the volume, since its Pearson correlation coefficient turned out to be equal to 0.784. Finally, it is concluded that it was determined that there is a direct and high relationship between the outlet pressure and the flow, in which its Pearson correlation coefficient turned out to be equal to 0.992. With them, the reliability of the data collected in relation to what the literature establishes between pressure, flow and volume was verified. In this way, the solution shown contributes to achieving the sustainability of the supply of drinking water to the population to whom the service is provided.

For future work, it is recommended that the Nemos N210 technology be incorporated not only into pressure reducing chambers, but also into all sub-systems of the drinking water network, in the case of reservoirs, re-pumping chambers, in order to reduce the level of water lost due to failures related to overflows or leaks in ducts or pipes.

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