IoT Based Monitoring and Control of Water Parameters

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Abstract

As the scientific revolutions are helping improve our day to day life, they are also making our environment polluted. Out of many components the most affected is water as most of the industrial waste is dumped into water untreated which pollutes the water and ultimately affect the life of common people who use that water for their day to day use. This paper presents the way of monitoring the parameters of water which could be viewed online using the mobile app. More over the system will also help to control the water wastage by automatically tripping the water valve after certain threshold set by the user.

keywords - *water parameters, IoT, pH, turbidity, and AT-mega*

I. INTRODUCTION

Water is not only the necessity to human beings but also other living creatures on the surface of earth and below the surface of earth. The untreated industrial waste is being dumped into the lakes and rivers which is contaminating the water for all living kinds. Similarly, no one bothers to care about the quality of water being provided at the residential sites in the third world countries. Some people store water in tanks built either at the top of the houses or in some cases below the houses. These tanks if not cleaned on time may grow fungus or other bacteria's which contaminate water and ultimately the health of the people using that water. Hence these problems call to modern technologies to treat them by monitoring them in real time [1]. The system is upgraded with the IoT technology so the parameters could be monitored in real time and in case of contamination the consumption of harmful water could be stopped. Sample of water from different tanks of different areas could be collected to compare and analyse the results.

The parameters such as pH of water which is basically the concentration of hydrogen ions in water. The pH level of water depicts if its acidic or alkaline in nature. The drinking water has a pH of 6.5-8.5 while the pH range lies between 0-14 where pH more than 7 is alkaline while below than 7 is acidic. Drinking water which has acidic pH can cause many health problems such as vomiting, diarrhoea, liver diseases, kidney disease and nausea are the most common one while alkaline water can decrease the stomach acids which basically kill the bacteria, it can cause skin problems and in some cases hand tremors.

Similarly, the suspended water particles should also be measured which defines the clarity of the water. In case of water tanks which are not cleaned properly fungus starts growing which contaminates the water which results in growth of pathogens and bacteria. This could be easily monitored using a turbidity sensor which measures the suspended particles in the water.

II. LITERATURE REVIEW

(R. P. N. Budiarti, a. Tjahjono, m. Hariadi and m. H. Purnomo) in their paper described a way for water quality monitoring using a raspberry pi which acts like a smart controller but it's an expensive module for the job to be performed here. They integrated the sensors with the controller and then a wi-fi module which is used for the internet of things (IoT) purpose. The system was implemented on the river Kali Surabaya in Indonesia [2]. Certain parameters of water like dissolved oxygen, total carbon, total nitrogen, and phosphorus were inspected by a team of researchers on tonghui river. It was discovered mild pollution levels near the factory areas. The quality of water was divided into 3 classes where class a defines the water to be clean and class c defines the water to be polluted the most. Techniques were provided to monitor these parameters and methods of control were suggested [3].

Such system for water quality monitoring should be designed which could be easily available to common people who can't afford expensive tech but wish to have facilities of life. In [4] provided a low-cost water quality monitoring system for drinking water and consumer sites. These researchers developed low cost sensor nodes for the water quality monitoring and these sensors were fixed in the pipes for monitoring the water quality. Nikhil Kedia constructed a system for water quality monitoring in rural areas where the tech is not that up to date and people lack awareness in regards to drinking clean water. He made a sensor-based cloud system for the water monitoring system. He also suggested that automatically improving the water quality is not feasible yet because water when polluted has complex chemical nature and its treatment could be complex and expensive so the easy way is to keep it clean by constant monitoring [1].

Water is not essential in regards to drinking but is also significant in agricultural use. Due to the rising population the demands for food production are also

rising. This calls for the steps which should be carried out to increase the production and one of these components is clean water which is enrich with minerals. Recent technologies have upgraded the water management system which are based on clouds and IoT helping save water. Wireless sensor networks are developed which are helping to optimise the use of water and not affect the crop yield. There are many issues regarding the water supply, water contamination, water reuse and monitoring distribution system [5].

The major task in developing any system is that it should be user friendly and cheap so that anyone can afford it. Considering these things, the efficiency of the system should not be compromised as well. The controllers being produced by the Atmel company are latest and have high efficiency with low costs. These controllers can be integrated with variety of sensors analogue or digital and the data could be processed by the controller in matter of seconds [6]. The controller could be programmed using c programming language or assembly language depending on user's choice.

III. METHODOLOGY

In this paper a method for water quality monitoring will be designed using advance sensor technology. The usage will also be limited using the flow sensors and relay-based valve which could be turned off using a digital signal from the controller. The data collected from the sensors is to be transmitted to the IoT based web portal or the mobile app where the user can observe it and turn the supply off if the water is contaminated.

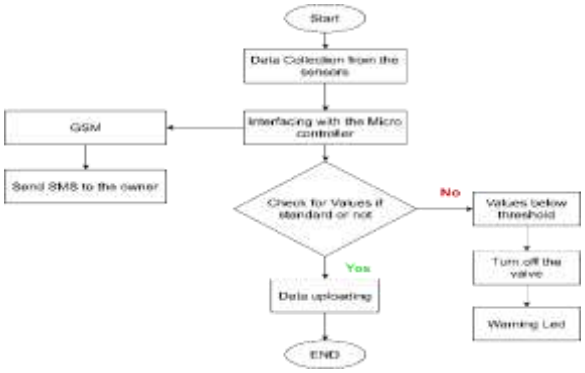

Fig. 1 flow diagram

The centre of the whole system here is the at-mega32 which is programmed using the c language programming. As shown in figure 1 the microcontroller is going to be the central part of the system which is the decision-making unit. Gsm module connected here is going to help the customers which do not have access to internet like people living in rural areas. They will be informed about their water quality via SMS service.

The controller used on this project at-mega is a 32kb controller which has a built-in analogue to digital converter which is quite reliable. It contains built in clocks and can execute instructions in single clock cycle. This device gives a great advantage in regards to operating voltage and is being widely used in domestic and industrial levels [7].

All solutions generate voltage depending on the number of hydrogen ions it has. More the number of ions in the solution the more acidic the solution is. This could be tested using a pH sensor. PH sensor in this model will be suspended in the water to check for whether the water is alkaline or acidic in nature. It is a 5v sensor and will be powered up using an externed power supply. For water to be in drinkable range it should have pH level between 6.5 to 8.5 and the pH levels below and above these levels makes the water harmful for drinking purposes.

The next parameter of the water to be monitored is the turbidity. This is the water clarity test and if water has any suspended particles. The fungus in water changes its colour or the dust particles make the water contaminated this all could be monitored by the turbidity sensor. The unit for turbidity is nephelometric turbidity unit and its highest value is 1024 which means the worst quality water. The working principle of this sensor is simple, beam of light is sent into water where it is dispersed by the particles and then received by the detection probe. Now it will check for the density of suspended particles, more light detected by the detection probe means more particles are present in the water.

Figure 1 shows the working of the system where the central processing which in this case is micro-controller will be programmed to get the data from the sensors and make decision according to the thresholds given to it. If the values are normal it will keep the water flowing but if it falls below that than the supply of water will be dropped. The controller will also be connected to a wi-fi module to get the access to internet so the data could be uploaded to a mobile app or cloud from it could be viewed by the consumer.

IV. RESULTS AND ANALYSIS

After the model was built different water samples were taken from the different areas of Peshawar, Pakistan. After comparison and analysis, it was concluded that the samples from the industrial areas were found to be more acidic and had more particles suspended. While in the samples from domestic areas the water had high turbidity because the water tanks installed in the houses were not cleaned properly and had large amount of fungus and algae in them.

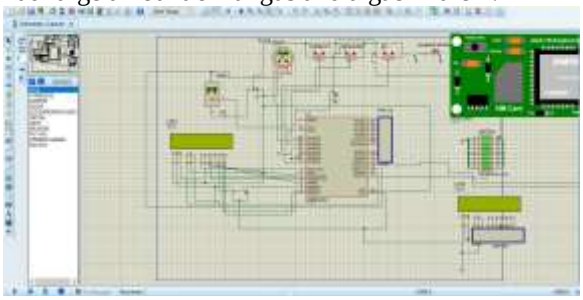

Fig. 2 Proteus Based Simulation

The model was first simulated in Protues so the errors in programming and results analysis could be done efficiently. Figure 2 gives a layout of the simulation where it can be observed that the main part of the system is the controller and all the sensors are attached to it. IoT testing was not possible in proteus so wireless wi-fi sender and receiver modules were used to test the data transfer.

Fig. 3 Hardware Circuit

Figure 3 shows the implemented circuit for the designed module. The results received from the sensors were then also compared to the lab tests of the same samples and it confirmed the output and accuracy of the results to be 94%.

Area	PH	Turbidity nephelometric	Temperature °c	Pressure pa
Industrial estate	4.3	381	33	30.0
Residential area	7.3	0.0	23	30.0
Commercial area	5.7	680	26	30.0

Table 1 Data Received from Different Water Samples

Table 1 shows the results for water samples which were taken from different areas of Peshawar. It was found that the water in industrial estate and commercial sites was not of drinking quality due to its acidic and basic nature. The water at both these sites was also unclear. This was mainly because at commercial sites the water was contaminated by the dust and waste bags while at industrial cites it was being polluted by the industrial waste. The samples from the residential areas gave positive results as expected and it was safe for drinking.

The data received from the sensors was viewed by using an app where all the data was uploaded via internet source.

Fig. 4 IoT Based App

The figure 3 shows the layout of the app where the observer can view the values, he/she is receiving from the sensors. A solenoid-based button was created to turn on or off the supply of water in case of an emergency. The flow section here measures the usage of water for the user and turns the supply off after the certain threshold given.

V. CONCLUSION

The goal for this project was to develop a system which is user friendly and conveniently built to check the basic water features so the prevention techniques could be used to avoid any hazard that could be caused to human health. This paper provides all the necessary tools required to build such a system which is not only economical but also efficient and accurate. The data uploaded to the cloud can viewed anytime and anywhere having an internet facility. For rural areas where the facility of internet is not very much common a gsm module was integrated to inform the user about the quality of water supply, he is using. More over this project also limited the water consumption and is one of the best applications for monitoring water parameters.

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