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REAL TIME CONTAMINATION DETECTION IN DRINKING WATER DISTRIBUTION SYSTEM USING LOW COST SENSOR NETWORK- A REVIEW

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Abstract: This Paper presents low cost sensor network based real time contamination detection in drinking water distribution system. A set of automatic measurement and reporting system of water quality has been developed. This system consists of multiple sensors of water quality testing, microcontroller, information transmission module, monitoring center and other accessories. Various parameters of water quality are automatically detected under the control of single chip microcontroller all day. Extensive literature and market research is performed to identify low cost, on-line sensors that can reliably monitor several parameters which can be used to infer the water quality. Based on selected parameters a sensor array is developed for analog signal conditioning, processing, logging, and remote presentation of data. The parameters which are selected in this system are turbidity, temperature, dissolved oxygen, pH and free residual chlorine. The samples taken by the sensors is send to the microcontroller then microcontroller process this data, the processed data is then instantaneously send to monitoring center by zigbee network, if the water quality is abnormal it is convenient for management center to take corresponding measures timely. The system has realized the automation of water quality monitoring, intelligence of data analyzing and networking of information transferring. It is characterized by advantages of shortcut, accuracy material resources sparingly. The system has widespread application value and can be extended and transplanted to other fields of automatic monitoring where needed

Keywords: Component Sensor Network, Arm Processor, Zigbee

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INTRODUCTION

Clean drinking water is important for the health and well-being of all humans. As the country is making its progress through industrialization, our water resources are prone to a threat of pollution especially from the industrial activities. It is a challenge in the enforcement aspect as it is impossible for the authorities to continuously monitor the location of water resources. The traditional method of monitoring water quality is to collect samples manually and then send them to laboratory for analysis. However, it has been unable to meet the demands of water quality monitoring today due to limitation as the samples are taken at limited areas and long gap between the samples taken and result obtained. So, it is important to have such a monitoring system which can take the samples in real time and is of, low cost, reliable and flexible. So a set of sensor measurement and reporting system of water quality has been developed. According to WHO (world health organization) there are several parameters which effect the water quality such as chemical substances, conductivity, dissolved oxygen, pH, turbidity and temperature. Therefore the parameters which are selected in this system are turbidity, temperature, dissolved oxygen, pH and free residual chlorine.

This system consists of several in line sensors fitted into the water distribution pipe. the sensors continuously take the samples which are in analog form this analog data is then send to the ARN7TDMI microcontroller which is having an inbuilt analog to digital converter which will convert analog data from sensors into digital form then this data from sensors is processed by the microcontroller and the data is displayed on LCD screen. The processed data from microcontroller is send to the monitoring system with the help of zegbee, which is a wireless communication protocol for transmitting and receiving of data wirelessly. The microcontroller is connected to zegbee by Db9 connector at transmitter and at the receiver monitoring station connected to zigbee for receving data by RS232 connector. The development of graphical user interface (GUI) for the monitoring purposes at the monitoring station is another main component in the project. The GUI should be able to continuously display the parameters being monitored.

II LITREATURE REVIEW

A limited number of on-line, reagent-free water monitoring systems exist (e.g. Hach HST Guardian Blue [1], JMAR BioSentry [2]), but these systems are bulky (sensors are installed in flow cells located in cabinets) and remain cost prohibitive for large scale deployments. A chemical sensor array for water quality monitoring based on thick film technology is presented in [3], [4] ,[5]and [6] these sensors are very low cost, though they have limited lifetime (few months) and require a conventional glass reference electrode to operate accurately. A

multiparametric sensor array based on semiconductor ruthenium oxide nanostructures is proposed in [7]. [8]Multi-sensor heterogeneous real time water monitoring system using the parameters like ph, temperature, conductivity, turbidity and dissolved oxygen was proposed. [9] Used a satellite with chlorophyll concentration and neural network to predict status of lakes and reservoirs. Postolache et al. [10] used GPRS and a Kohonen SOM (Self organizing Map) to monitor water quality in real time. Brockmann and Stelzer [11] introduced water quality monitoring of coastlines. Wang et al [12] deployed Zigbee technology to construct water monitoring system.

The above research papers studied so far, demonstrate the effective use of sensor network for water monitoring and contamination detection. However, most of the papers have proposed various schemes to make this system effective and efficient but some of these schemes are costly due to high cost of sensors and some of the sensors used have short life time. Papers where field deployment is done that is not suitable for some of the important parameters of water quality. So it is necessary to design and implement a system by taking the requirement of multiple parameters of water quality using low cost sensor and system design

III PROPOSED WORK

Drinking water quality standards are determined according to World Health Organization guidelines. These organizations set the standards for drinking water quality parameters indicate which microbiological, chemical and indicator parameters must be monitored and tested regularly in order to protect the health of the consumers and to make sure the water is wholesome and clean. Table I enumerates the suggested parameters to be monitored from high to low correlation significance when interpreting water contaminations

TABLE 1: Suggested Parameter to Be Monitored.

Sr no	parameters	Units	Quality range
1	Turbidity	NTU	0 – 5
2	Free residual chlorine	mg/L	6.5 - 8.5
3	Temperature	‘C	-
4	pH	pH	7
5	Dissolved oxygen	mg/L	0.2 – 2

This paper would take the opportunity to design a system that is able to monitor the various parameter of water quality in real time. The system represented in this paper is composed of the sensor array, microcontroller, zegbee, device control node and personal computer. The sensor network data collecting node is connected with temperature, turbidity pH, free residual chlorine and dissolved oxygen sensor. This sensors are placed in water distribution pipe and the data collected by this sensor are send to the microcontroller then the data will be processed by microcontroller and this data will be send wirelessly by zigbee to monitoring station where data is collected by zigbee transceiver

and at the monitoring station the processed data can be seen on computer

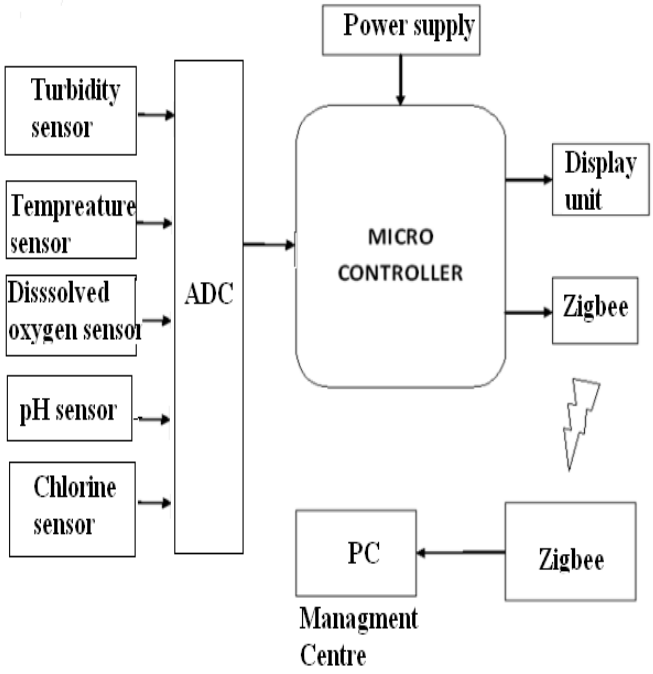

Fig 1. Block diagram of System

IV Components

A. Sensor Node

Sensor node is basically consists of several sensors used to detect the predetermined parameters that indicate the quality of water. In this work, five types of sensor; pH sensor, temperature sensor, dissolved oxygen sensor. Residual chlorine and turbidity sensor are used. The information being sensed by the sensors are then converted into electrical signal and go through the signal conditioning circuit that functions to make sure the voltage or current produced by the sensors is proportional to the actual values of parameters being sensed. Then it is passed to a microcontroller that processes it to the value understandable by human

B. Base Monitoring Station

The base station consists of a same Zigbee module programmed as a coordinator that receives the data sent from the sensor nodes wirelessly. Data received from the end device nodes is sent to the computer using the RS 232 protocol and data received is displayed using the inbuilt GUI on the base monitoring station

C. PIC Microcontroller

A PIC microcontroller is a processor with builtin memory and RAM and you can use it to control your system. So it save your building a circuit that has separate external RAM, ROM and peripheral chips.

D. Zigbee Network

Area networks Zigbee is a specification for a suite of high level communication protocols using small, low-power digital radios based on an IEEE 802 standard

E. PH Sensor

pH is an important parameter to be measured and controlled. The pH of a solution indicates how acidic or basic (alkaline) it is. The pH term translates the values of the hydrogen ion concentration- which ordinarily ranges between 0 and 14. On the pH scale a very acidic solution has a low pH value such as 0, 1, or 2 (which corresponds to a large concentration of hydrogen ion and base solution has high pH value such as 8, 9 or 10

F. Dissolved Oxygen (DO) Sensor

Dissolved Oxygen (DO) is the term used for the measurement of the amount of oxygen dissolved in a unit volume of water. In water quality applications, such as waste water treatment, the level of DO must be kept high. In sewage treatment, bacteria decompose the solids. If the DO level is too low, the bacteria will die and decomposition ceases; if the DO level is too high, energy is wasted in the aeration of the water. With industrial applications including boilers, the make-up water must have low DO levels to prevent corrosion and boiler scale build-up which inhibits heat transfer. Although dissolved oxygen (DO) is usually displayed as mg/L or ppm, DO sensors do not measure the actual amount of oxygen in water, but instead measure partial pressure of oxygen in water. Oxygen pressure is dependent on both salinity and temperature.

G. Turbidity Sensor

One of the most important parameters that require monitoring in a wash process is turbidity, a measure of the dirt, food or other particles suspended in the solution. As the photons that make up a beam of light pass through the liquid being tested, some are reflected by the particles suspended in the solution while others pass through unimpeded. The dirtier the water, the less light gets through and the more it is scattered. The turbidity of the water is determined by analysis of the ratio of the scattered light signal divided by the transmitted light signal.

H. Residual chlorine sensor

Residual chlorine is the amount of chlorine that remains in water after a certain period or contact time. Residual chlorine composed of dissolved hypochlorite ions, hypochlorous acid and chlorine gas.

V CONCLUSION

The proposed system in this paper is designed by considering the requirement of a real time monitoring of drinking water using low cost sensor network. The proposed system consist of several in-pipe water quality sensors, transceiver for communication, microcontroller for processing the data it is low cost, lightweight and high performance. Such implementation is suitable for large deployments enabling a sensor network approach for providing spatiotemporally rich data to water consumers, water companies and authorities.

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