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Water Parameters Monitoring in Real Time Using Sensor Network and ZigBee

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Abstract- In this paper a system for monitoring the quality of the water in real time is proposed. Various parameters of the water which gets affected due to the impurities in water are monitored continuously. The importance is given to the low cost of the sensors used, low power consumption and wireless error free transmission using zigbee .ARM7 processor is used for processing the detected values and this values will be then send to the management centre. Hyper terminal software platform is used to continuously monitor the data at the management centre. Various samples of water were taken to evaluate and validate the performance of the system. Experimental result thus obtained using this system shows that the system is reliable for large scale deployments

Keywords— *ARM7 processor, zigbee, management centre, Hyper terminal*

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I INTRODUCTION

Contamination free drinking water is one of the most important resources for the health of human beings. But drinking water gets contaminated due to industrial waste. pollution and thus facing several challenges in their real time operation and thus there is a need of monitoring the water in real time, as the laboratory-based methods are not reliable because they are too slow to detect the contamination in water in real time. So there is need for rapid detection of drinking water distribution system.

The traditional method for water contamination detection is the laboratory method, in which samples from different location is collected and this samples are taken to laboratory followed by laboratory analytical technique for detecting the contamination in water. But this method is not reliable because of long time difference between samples taken and results obtained and also the small number of locations is sampled. So there is a clear need of real time water monitoring system with efficient spatio-temporal resolution. So a set of automatic measurement and reporting system of water quality has been developed. This system consists of multiple sensors of water quality testing, single-chip microcontroller, data acquisition module, information transmission module, monitoring center and other accessories. Various parameters of water quality are automatically detected under the control of single chip micro controller all day. The micro controller gets the data from different sensors then processes it and analyzes them. After that, the data is instantaneously sent to monitoring center by zigbee network, if the water quality is abnormal, it is convenient for management to take corresponding measures timely and be able to detect real-time situation of water quality remotely. The system has realized the automation of water quality monitoring, intelligence of data analysing and networking of information transferring. It is characterized by advantages of shortcut, accuracy and using manpower and material resources sparingly. The system has widespread application value and can be extended and transplanted to other fields of automatic monitoring where needed.

II RELEATED WORK

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 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 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

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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

Due to increase in the level of contamination in drinking water and detecting the contamination by laboratory methods are time consuming. These methods have long time gap between the sample taken and results obtained, so a real time monitoring system is developed to monitor the water continuously in real time. There are several parameters like pH, turbidity, dissolved oxygen, temperature, chlorine concentration, ORP, nitrates, electrical conductivity which gets affected due to the abnormalities present in the water and by monitoring these parameters contamination can be detected. Therefore the parameters that are selected in this system are turbidity, pH, temperature and dissolved oxygen. In order to increase the pervasiveness, testing equipment can be placed in the water distribution pipe or tank and the results can be seen at the monitoring station. Fig 1 shows the block diagram of the proposed system

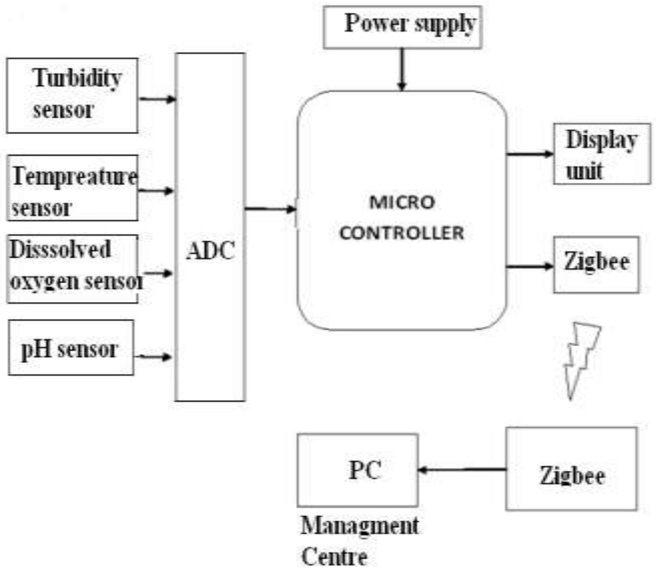

Fig 1: Block diagram of system

IV SYSTEM HARDWARE DESIGN

The modules included in the system hardware are as follows:
1, Sensor module's

A. Turbidity sensor
B. pH sensor
C. Temperature sensor
D. Dissolved oxygen sensor

2. ARM7 Processor
3. Zigbee
4. Monitoring centre

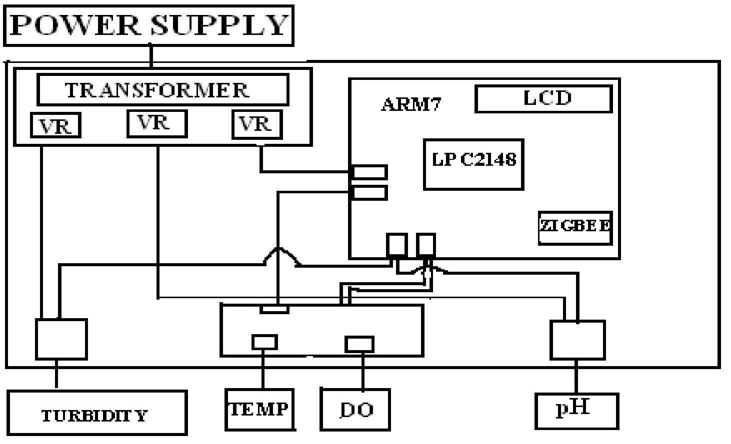

Fig 2: central node circuit

1. SENSOR MODULES

A. Turbidity Sensor

It is one of the most important parameters that require monitoring in a wash process, a measure of the dirt, food or other particles suspended in the solution. Current technology to measure turbidity depends on optical techniques, where water or other fluids pass through a tube or vessel and a beam of light is transmitted through a cross section of the vessel. 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. Two optical detectors-one positioned head on to the light source, the other at an angle of 90° to the light source-measure the transmitted and scattered light photons respectively. 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.

B. pH Sensor

In the process world, 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 ions) while a very basic solution has a high pH value, such as 12, 13, or 14 which corresponds to a small number of hydrogen ions .A neutral solution such as water has a pH of approximately 7.. A pH measurement loop is essentially a battery where the positive terminal is the measuring electrode and the negative terminal is the reference electrode. The measuring electrode, which is sensitive to the hydrogen ion, develops a potential (voltage) directly related to the hydrogen ion concentration of the solution. The reference electrode provides a stable potential against which the measuring electrode can be compared.

C. Dissolved Oxygen 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 aquaculture (including fish farming) and waste water treatment, the level of DO must be kept high. For aquaculture if the DO level falls too low the fish will suffocate. 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.

D. Temperature Sensor

The LM35 series are precision integrated-circuit temperature sensors, whose output voltage is linearly proportional to the Celsius (Centigrade) temperature. The LM35 thus has an advantage over linear temperature sensors calibrated in ° Kelvin, as the user is not required to subtract a large constant voltage from its output to obtain convenient Centigrade scaling. The LM35's low output impedance, linear output, and precise inherent calibration make interfacing to readout or control circuitry especially easy. It can be used with single power supplies, or with plus and minus supplies.

2. ARM7 PROCESSO**R**

The ARM7TDMI core is a 32-bit embedded RISC processor delivered as a hard macro cell optimized to provide the best combination of performance, power and area characteristics. The ARM7TDMI core enables system designers to build embedded devices requiring small size, low power and high performance

ARM7TDMI Features

- 32/16-bit RISC architecture (ARM v4T)
- 32-bit ARM instruction set for maximum performance and flexibility
- 16-bit Thumb instruction set for increased code density
- Unified bus interface, 32-bit data bus carries both instructions and data
- Three-stage pipeline
- 32-bit ALU
- Very small die size and low power consumption

3. ZIGBEE

Zigbee is a specification for a suite of high level communication protocols using small, low-power digital radios based on an IEEE 802 standard for personal area networks. The low cost allows the technology to be widely deployed in wireless control and monitoring applications, the low power-usage allows longer life with smaller batteries, and the mesh networking provides high reliability and larger range.

4. MONITERING CENTRE

The base monitoring centre 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 built in software in personal computer called hyper terminal

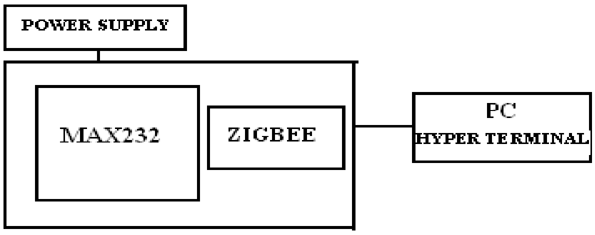

Fig 3: receiver circuit

V SOFTWARE PLATFORM

The platform called hyper terminal is used at the base station for displaying the values detected by the sensors. This software platform (hyper terminal) is inbuilt in personal computers.

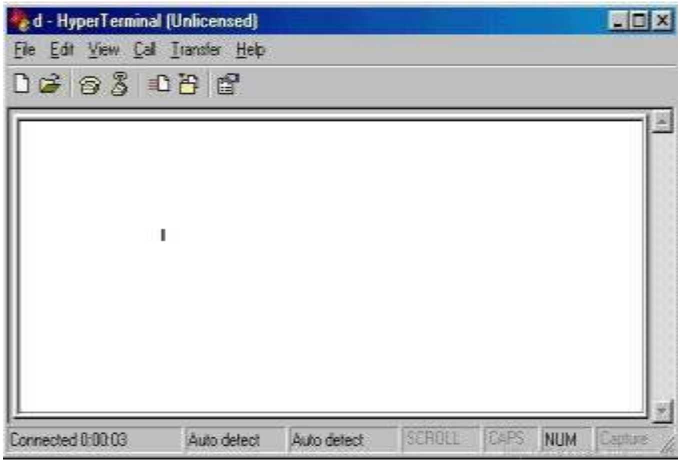

Fig 4: software platform

The software platform at the monitoring centre used for displaying the values detected by the sensors is shown in fig 4 the values detected by the sensors can be seen on this hyper terminal software platform

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Steps to get software platform

Start

↓

All programs

↓

Accessories

↓

Communication

↓

Hyper terminal

VI IMPLEMENTATION

The fig 5 shows the complete system photo in which there are four sensors connected to the ARM7 board. That are connected are pH, turbidity, dissolved oxygen and temperature. As the ARM7 processor requires 3.5v voltage supply and voltage being supplied is 230v, therefore voltage regulator circuit is being developed to convert 230v into 3.5v as well as into 5v for the sensors. A zigbee module is placed into the ARM processor for transferring the data to the monitoring station. Keil software is used for developing the embedded application and flash magic for dumping into the LPC2148 microcontroller

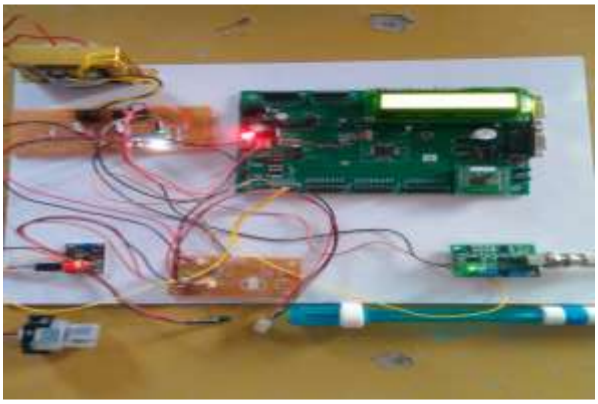

Fig 5: complete system photo

The fig 6 shows the zigbee module which is connected at the monitoring station for receiving the data from the sensor. Max232 IC is connected to convert the data in TTL logic form, also 9v battery is used to supply power to the zigbee. A db9 connecter and RS232 cable is used to connect zigbee to computer through UART

Fig 6: photo of zigbee module

VII RESULTS

Various experimental trials were performed to validate the behaviour and evaluate the performance of the developed hardware and algorithm. First the clean drinking water was taken and the values obtained for this sample of water was taken as reference. Various samples of water were taken and the detected values were analysed by comparing this with the reference values and the contamination level of water is known. The fig 7 shows the values detected for the clean drinking water on HyperTerminal software platform.

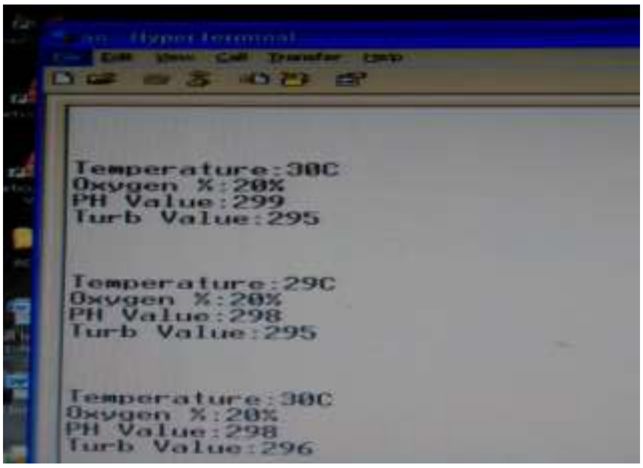

Fig 7: measurement status of every sensor nodes

VIII CONCLUSION

Therefore, the proposed system of real time water contamination detection using low cost sensor network is presented. The use of low cost sensor network makes this system reliable to use at municipal and industrial level. Also the easy installation of the system and computer as the monitoring station is one of the most important factor of the system. The system can be placed at local area distribution tank and the detect values can be seen on the computers at the monitoring station. The system can be handled by any person with minimal training at the beginning of the installation

REFRENCES

[1] Hach HST, *GuardianBlue Early Warning System Brochure*.

[2] JMAR, *BioSentry Contamination Warning System Technical Overview*

[3] M. Sophocleous, M. Glanc, Monika, J. Atkinson, and E. Garcia-Breijo, "The effect on performance of Fabrication parameter variations of thick-film screen printed silver/silver chloride potentiometric reference electrodes," *Sens. Actuators A, Phys.*, vol. 197, pp. 1–8, Aug. 2013.

[4] J.Atkinson, J. M. Glanc, M. Prakorbjanya, M. Sophocleous, R. Sion, and E. Garcia-Breijo, "Thick film screen printed environmental and chemical sensor array reference electrodes suitable for subterranean and subaqueous deployments," *Microelectron. Int.*, vol. 30, no. 2, pp. 92–98, 2013.

[5] R. M. Manez, J. Soto, E. G. Breijo, J. I. Civera, and E. G. Morant, "System for determining water quality with thick-film

ISSN: 2321-8169
133 – 137

multisensor," in Proc. Spanish Conf. Electron Devices, Feb. 2005, pp. 607–610.

[6] R. Martinez-Manez, J. Soto, E. García-Breijo, L. Gil, J. Ibanez, and E. Gadea, "A multisensor in thick-film technology for water quality control," Sens. Actuators A, Phys., vol. 120, no. 2, pp. 589–595, 2005.

[7] S. Zhuiykov, D. O'Brien, and M. Best, "Water quality assessment by integrated multi-sensor based on semiconductor RuO2 nanostructures,"Meas.Sci. Technol., vol. 20, no. 9, p. 095201, 2009.

[8] S. Panguluri, G. Meiners, J. Hall, and J. G. Szabo, "Distribution system Water quality monitoring: Sensor Technology evaluation methodology and results," U.S. Environ. Protection Agency, Washington, DC, USA, Tech. Rep. EPA/600/R-09/076, 2009. 2772 IEEE SENSORS JOURNAL, VOL. 14, NO. 8, AUGUST 2014

[9] H. M. C. Ribeiro, A. C. Almeida, B. R. P. Rocha, and A. V. Krusche, "Water quality monitoring in large reservoirs using remote sensing and neural networks," IEEE Latin America Transactions, vol. 6, no. 5 419–423, Sept. 2008

[10] O. A. Postolache, P. M. B. S. Girao, J. M. D. Pereira, and H. M. G. Ramo, "Self-organizing maps application in a remote water quality monitoring system," IEEE Transactions on Instrumentation and Meaurement, vol. 54, no. 1, pp. 322–329, Feb. 2005.

[11] C. Brockmann and K. Stelzer, "Monitoring of Water Quality in the Coastal Zone Using Optical Remote Sensing," in Proc. of IEEE OCEANS'09, pp. 1–5, Bremen, Germany, Oct. 2009

[12] Z. Wang, Q. Wang, and X. Hao, "The Design of the Remote Water Quality Monitoring System based on WSN," 5th International Conference on *Wireless Communications*, pp. 1–4, Beijing, China, Sept. 2009