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WATER QUALITY MONITORING SYSTEM BASED ON WIRELESS SENSOR NETWORK

Ashwini V. Mulay
SKN Sinhgad College of Engineering
Korti Pandharpur (INDIA)

Kailash J. Karande
SKN Sinhgad college of Engineering
Korti Pandharpur (INDIA)

Abstract- The use of wireless sensors gives us a more precise way to get the water quality status at different places and may allow the enduring and easy deployment of monitoring stations at places of difficult access without the manual data retrieval. The proposed system can sense the different water parameters from water bodies continuously and send the real-time data to the monitoring station using wireless technology to check the water quality. Using different sensors, this system will collect various parameters from water, such as pH, turbidity and Dissolved Oxygen etc. The wireless sensor node consists of microcontroller, transceiver, external memory, power source and one or more sensors. The rapid development of wireless sensor network (WSN) technology provides us a real-time data acquisition, transmission and data processing.

Keywords- WSN, pH, data acquisition, Turbidity

I. INTRODUCTION

Every living thing on earth needs water to survive. Water found in nature contains a number of impurities in varying amounts. As water is a universal solvent, water absorbs number of impurities in various ways like water runoff, etc. The impurities which are picked up by the water as suspended water sometimes make it more useful and suitable for drinking, but sometimes, it may make water totally harmful and unfit for drinking purpose and sometimes unfit for some other purposes. In some places such as in [1] describes that the pollutant effluent derived from mining sites has affected the underground water source such as wells, one of the important water source for people in rural area. Water quality is always an enormous issue, partly because of the tremendous growth of population & urban expansion and development. The quality of water will not suffer, if people are diligent. So in a water supply project, quality of water is an important factor. Water quality analysis is the analysis of raw water to know various impurities present in it and for deciding the treatment of water.

Water quality affects because of surrounding conditions, environmental changes so there is necessity of regular testing. So continuous monitoring (in contrast to casual monitoring which is Manual collection and testing) of water quality will make sure us of its use. Currently, low resolution water quality monitoring is conducted, and water samples are manually collected at regular periods for chemical analysis and send the water samples to the laboratory. Such approaches are no longer considered efficient [9]. Continuous monitoring of surface water is imperative for continuous assessment of its ecological health, as well as anticipation.

Recently, wireless radio frequency technology has been widely used the solution in various surrounding application either to give wireless data transmission or remote controlling system. Hence, the Wireless Sensor Network (WSN) is an important and ideal technology platform for environmental remote monitoring infrastructure by looking at the benefits of its low power consumption and cost, smaller scale of size, networking, sensing flexibility, and mobility of nodes.

The proposed system can sense the water parameters using sensor node from the water bodies continuously and send the data to monitoring station called as a base station, using wireless technology. The system will use different sensors to collect various parameters from water bodies, such as pH, dissolved oxygen, and turbidity, etc. The wireless sensor network (WSN) technology provides us a real-time data acquisition, transmission and processing as in [3][5]. There are different technologies which are used Wireless communication. A wireless sensor node has not only a sensing component, but also on-board processing, communication, and storage capabilities. Sensor node communicates with a base station BS using their wireless communication channel, allowing them to disseminate their sensor data for remote processing, visualization, analysis, and storage systems. The base station is usually a PC with Graphic User Interface (GUI) for users to analyse water quality data or alarm automatically when water quality detected is below specific standards.

This paper is organized as follows. Section II explains need of water quality monitoring. Section III reviews related work. Section IV presents system design and paper is concluded with Section V.

II. NEED OF CONTINUOUS MONITORING

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Polluted water became a very serious issue from the last few decades. Growing population, discharge of toxic chemicals, untreated sewage, climate change and other human activities impact water resources in densely populated regions, if not handled effectively. Therefore, water surveillance becomes important to control the level of contamination in water. In manual testing there is the collection of water samples manually from the source of water or from water bodies and send collected water samples to the laboratory for testing as explained in [7]. Water quality changes with time, so there is a necessity of repeated measurements to characterize variations in quality effectively.

III. RELATED WORK

The SunSPOT in [2] is used to transmit data to the base station through WSN. The SunSPOT is programmable WSN transceiver software communication architecture designed based on Sun's Small Programmable Object Technology. The pH probe IH20, Redox sensor to measure density of oxygen and turbidity sensor is used in this system. The Paper [4] describes three types of nodes with different firmware coding are used such as sensor node, repeat node and the main node to monitor water quality in the water pools. A wireless signal path from the sensor node to repeat node proffers a single direction relaying method, thereby making the sensor node & repeat node to be in sleep mode when idle. Single direction transmission method is used to reduce power consumption. An approach of Wireless Sensor Network application to do real-time data collection at the fresh water resources is described in [3]. The WSN system is used as a platform to monitor the fresh water quality readings, deployed at a distributed location which each node will able to interface with various water quality sensors. Sensor nodes are connected through coordinator device according to unique PAN (Personal Area Network). A low cost wireless water physiochemistry sensing system is presented in [7] which allow catchment managers to continuously monitor the quality of the water at higher spatial resolution and to maintain surveillance. In this Arduino Mega 2560 is used as the sensor node to acquire and process sensor data.

IV) PROPOSED SYSTEM OVERVIEW

As water is needed to be tested regularly, the system should be monitor water parameters continuously. To monitor water quality in different sites in real time, an architecture constructed by distributing sensor nodes and base station is suggested in [2] [8]. Fig1 shows an overview of system architecture. The system shows sensor node unit located at the remote station. The sensors are connected to the sensor node unit to sense the physical parameter. At the base station, PC is connected to the base station node unit which receives the data from the sensor node unit. The Proposed system is continuous monitoring of different water parameters sensed using different sensors which are located at remote places or sources. For continuous monitoring of these physical parameters of water we can use wireless sensor network system. The Wireless Sensor Network system is composed of base station unit and sensor node unit. The Proposed water quality monitoring system is made up by the base station and sensor nodes. The wireless sensor nodes are the vital element in a wireless sensor network (WSN). It keeps and executes the communication protocols, and the data-processing algorithms. The sensor nodes are located in different places where we need to monitor water quality. The base station unit contains a wireless receiver and PC, where users can receive data from sensor nodes and analyze it. The base station and nodes are connected via WSN technology.

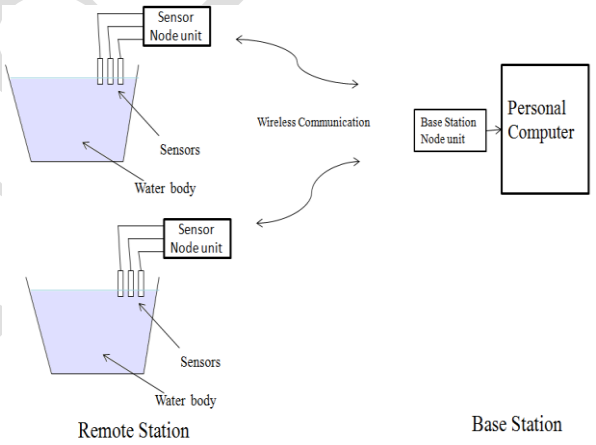

Fig1. System Architecture

A. SENSOR NODE UNIT

The Sensor node unit is shown in Fig2 is the proposed system in this work. Chemical parameters including pH & Dissolved Oxygen measuring is an important gauge of water quality. Changes in dissolved oxygen levels include the presence of microorganisms from sewage, urban or agriculture run-off or discharge from factories. pH is the measurement of Hydrogen ion concentration. pH is a measure of the acidity or alkalinity of a water solution. pH sensor generates voltage signals proportional to the pH. This signal must be amplified before they can be properly interpreted by the microcontroller. Dissolved Oxygen is an essential parameter which is necessary to be tested as explained in [6]. Its connection with water body gives direct and indirect information about bacterial activity, availability of nutrients, stratification, etc. Turbidity is the cloudiness or

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haziness of a fluid caused by a huge number of individual particles that are generally invisible to the naked eye, similar to smoke in the air. The measurement of turbidity is a key test of water quality. The pH sensor, Dissolved Oxygen sensor, turbidity sensor specification is as follows.

1. pH: The system uses pH sensor. pH range of reading is from 0 to 14. It works in the ambient temperature range which is of -40^0 to 70^0 C. pH sensor is connected through BNC connector.

2. Dissolved Oxygen: Galvanic cell method may used to measure dissolved oxygen content in the range of 0-20 mg/L. It operates in a temperature range of 50^0 C.

3. Turbidity: There is different turbidity sensors are used to measure turbidity of water.

The signal conditioning circuit is used to manipulate an analog signal which is output of sensors in such a way that it meets the requirement of the next stage for further processing. The output voltage of the sensors must be amplified to the appropriate levels before they can be read by the analog-to-digital converter in the next unit.

The main function of processing module is to process or execute the instructions relating to sensing, data transmission, etc. The Processing unit converts the voltage signals from the signal conditioning circuits to numerical data, format the data into data packets, and then send the data packet to the wireless communication module for transmission.

In Wireless Communication module data received from processing unit is transmitted wirelessly at the base station.

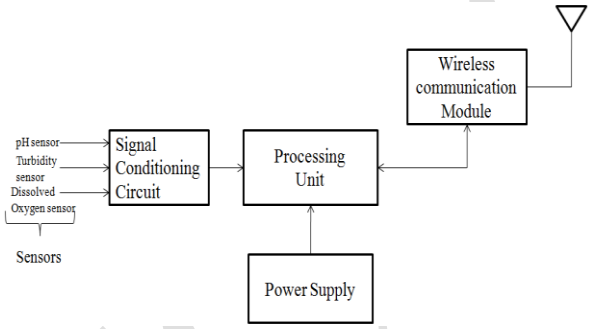

Fig2. Sensor Node Unit

B. Base Station unit

Data transmitted by the Wireless Communication module of the sensor node unit is received wirelessly by the wireless communication module of base Station as represented in Fig3. There are different wireless technologies can be used for data transmission and reception called as a transceiver pair of wireless communication module.

The interchange of serial binary data between two devices is needed. So RS232 interface is used in between Wireless Communication module and a Personal Computer at the base station and it is called as serial interface.

Personal Computer Collects data from the sensor node unit by using pairs of wireless communication module and store it for later work, display the data so that user can analyse it.

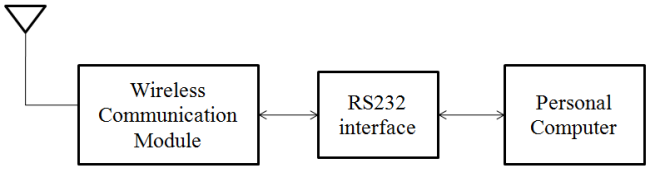

Fig3. Base Station Unit

V.CONCLUSION

The paper is an overview of the proposed system Water Quality Monitoring using Wireless Sensor Network. This system will be able to monitor quality of water regularly by using wireless sensor network. Monitoring the quality of water & collecting comprehensive data will achieve regular follow up of the water status of different places where system will be implemented with help of sensor nodes.

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