Development and Testing of Real Time Water Quality Monitoring System for Lakes

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***Abstract*—"Water pollution is one of the biggest fears for the greenglobalization". At present, water parameters are identified by chemical analysis or laboratory test, where the testing equipment is stationary and samples are provided to testing equipment. Thus the current water quality monitoring system is a manual system with tedious process and is very time consuming. In order to increase the frequency, the testing equipment can be placed in the river water and detection of pollution can be made remotely. This paper intends a wireless sensor-based Water Quality Monitoring System. Data collected by the base station is sent to the remote monitoring station. Data collected at the remote site can be displayed in visual format on PC with the help of MATLAB and is also compared with standard values. If the obtained value is above the verge value automated warning SMS alert will be sent to the agent. The proposed paper is to obtain the water monitoring system with high frequency, high mobility, and low powered. This kind of execution is suitable for large scale deployments, which enable the sensor network to provide data to the water authorities.**

Keywords: Continuous monitoring; GSM modem; Real-time; Sensors; WSN; GUI

I. INTRODUCTION

'Water pollution is the major problem in front of world', water pollution occurs when contaminants are discharged directly or indirectly into water bodies. Water pollution affects plants and creatures living in these bodies of water. Also human health is affected by polluted water.

Water Pollution is a major global problem which requires ongoing valuation and modification of water resource guiding principle at the levels of international down to individual wells. It has been surveyed that water pollution is the leading cause of deaths and diseases worldwide. The records show that more than 14,000 people die daily worldwide. In India its shockingly predictable about 580 people die of water pollution related illness every day. One of the reasons for this happening is the unawareness of public and administration. There are presently many schemes which are working towards cleaning out polluted water bodies. But after cleaning, they are again dirty. Many industries dump their industrial waste in the water bodies, so even recently cleaned water bodies start getting polluted. Currently, apart from the test mentioned above, there is no checking machinery for keeping a check on water quality and deprivation levels. So the lack of water quality monitoring system which creates serious health issues. Also natural phenomena such as, algae tints, rainstorms,and earthquakes also change the quality and ecological status of water.

With the rise of Internet of Things, wireless sensor networks are widely used. Wireless sensor networks, nodes through the wireless channel connection, self-organizing network topology, collaboration between nodes, timeliness, with a strong tractability.

At present, WSNs are used in many water quality detection situations, but basically are focused on the observing of a single small-scale water [6], However, the water quality and soil linkage of rural imbibing water sources proposed in this paper can not only detect water and soil pollution in a large scale and real time, but also play a guiding role in authority that helps to monitor the quality of water with the help of information sensed by the sensors immersed in water, so as to keep the water resource within a standard described for domestic usage and to be able to take necessary actions to restore the health of the degraded water body. Using different sensors, this system can collect various parameters from water, such as temperature, pH, oxygen density, turbidity and so on. The rapid development of WSNs technology provides a novel approach to real-time data acquisition, transmission and processing.. In a system of this kind, there are several nodes, a base station and a remote monitoring station. Each node contains a group of sensors and the nodes are circulated in distinctive water bodies. Data collected by sensor nodes is sent to the base station via WSN channel then to the remote monitoring station. The remote monitoring station is usually a PC with Graphic User Interface (GUI) for users to evaluate water quality data. The recorded data can be evaluated using various simulation tools for future correspondence and actions.

II. RELATED WORK

Central Water Commission (CWC) monitors water quality [3], by collecting samples from representative locations within the processing & distribution system. These samples are analyzed at the well-equipped laboratories. At these laboratories samples from raw water, filter water and treated water are taken for analysis. In these traditional systems the quality of water is monitored by collecting the samples of water from rivers, lakes and analysis was done in the laboratories which are located far from the water sources. The drawback of this kind of system was it is non-real time monitoring and confined to a small area and the entire process was costly. In the literature [5], the proposed system could not able to record the previous values and end user in

the remote location is not able to access this system and there is a complexity in the design in terms of different modules. The estimation of water parameters likes turbidity, pH, dissolved oxygen, etc. is done with the help of meters. So the disadvantages [5] of this existing system are that; there is no continuous and remote monitoring, human resource is required, less reliable, no monitoring at the source of waters i.e. no on field monitoring and the frequency of testing is very low. Due to these disadvantages of the existing system it is required to develop a system that will allow real time and continuous monitoring of water quality [7].

This system would have a Zigbee network that will be proficient in measuring various water quality parameters, a WiMax network and web based checking with the help of a controlling computer. The system is intended to collect and process information, thus making decisions in real time via a remote web server. Experimental results revels that the system is capable of observing water pollution in real time.

III. PROPOSED SYSTEM

The main aim here is to develop a system for continuous monitoring of water quality at remote places using wireless sensor networks with low power consumption, low cost and high detection accuracy. pH, conductivity, turbidity level, TDS etc are the parameters that are analyzed to improve the water quality. Following are the objectives of idea implementation [10], to collect data from various sensor nodes and send it to base station by wireless channel to simulate and analyze quality parameters for quality control.

A. Hardware Design:

The proposed water quality monitoring system based on WSN can be divided into three parts: • Data monitoring nodes • Data base station • Remote monitoring center (a) Data Monitoring Nodes Fig.2 illustrates the data monitoring nodes which consist of sensors (pH, turbidity and conductivity), signal conditioning circuit, a controller and RF module. The data sensed by the sensor will be passed through a signal conditioning circuit. Then the operated data will be given to the controller. The integral ADC will convert the analog signal to digital signal for further processing (b) Data Base Station the data from all the nodes is collected at the data base station consisting of processor as shown in fig.3. The data from each node is collected one after another i.e. using time multiplexing. This obtained data is displayed on a LCD display. Also, this data is forwarded to the remote monitoring station via Zigbee module. (c) Remote Monitoring Station the remotemonitoring station consists of a Zigbee module which will receive the data sent by the data base station. This data will be fed to a server PC consisting of Graphic User Interface via serial communication as shown in figure 3. The obtained data will be represented graphically with the help of MATLAB and will be saved for further reference. Also the obtained data is compared with the standard values of the water parameters. If the obtained water parameters do not match the preset values then SMS will be sending to an authorized person in order to take preventive measures.

B. Software Design:

Software design approach for water quality monitoring system is based on three parts, first is PIC programming, ARM programming and GUI design in MATLAB. PIC. The GUI platform is successfully developed using the MATLAB software which is able to interact with the hardware at the remote monitoring station. Detailed flowchart for the working of whole system as well as software design is shown in figure 4.

Fig.1: Prototype module

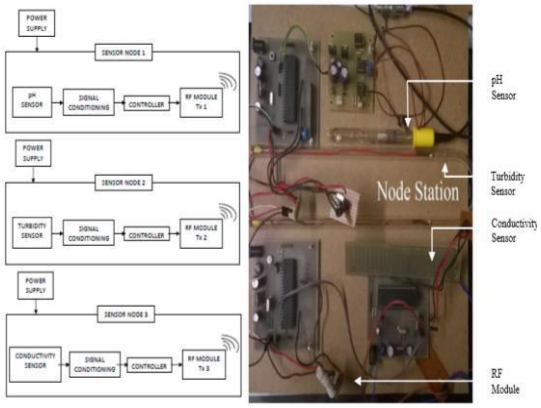

Fig 2: Data Monitoring Nodes

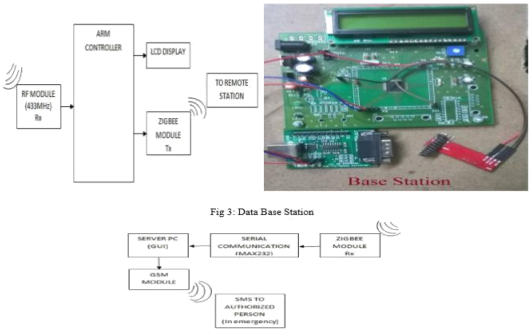

Fig 3: Data Base Station

Fig 3: Remote Monitoring Station

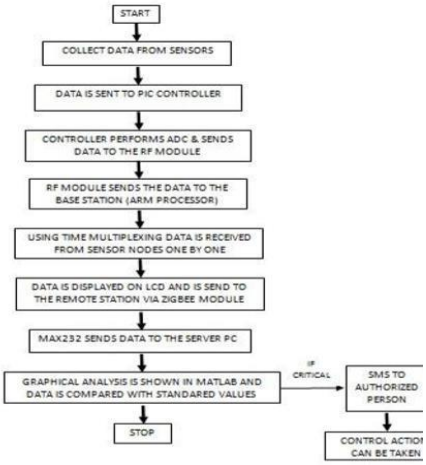

Fig 4: General Workflow of Water Quality Monitoring System

A.The pH Sensor The pH electrode contains a single cell battery having a high resistance which outputs a voltage linearly proportional to the pH of the water sample. The typical voltage output ranges from −430mV to +430mV.With an accuracy of ±0.02pH units.

B.The turbidity Sensor Turbidity is one of the important key test for measuring water quality. Units are measured in Nephelometric Turbidity Units (NTU) which measures the intensity of light scattered at 90 degrees as a beam of light passes through a water sample. The device measures from 0 to 3000 NTU turbidity value with a voltage range of 0−4.5V

C.The temperature Sensor the DS18B20 indicates the temperature device provides 9 to 12-bit (configurable) temperature readings. Max pressure 100 PSI o Temperature Range 1-99°C, Time before recalibration – 1 year of Life Expectancy of 2.5 years.

D.RF transmitter of Operational voltage 3v-12v Temperature +10c to +60c o Electrical power +5VDC +/-0.250 V DC Current Consumption: Transmitter: 10mA Reciever: 15mA Transceiver: 20mA of Frequency: 433.92MHz +/-200 KHz typical.

V. SIMULATION RESULTS

The graphical user interface using MATLAB, displaying results is shown in figure 8. Water parameters are collected from the nodes as shown in figure 2. Collected data is forwarded to the server PC with GUI shown in figures. From prior testing, a threshold value (range of values) is defined for the monitoring of temperature(Fig 5), turbidity (Fig.6) and conductivity of water. Depending on whether the normal of the values obtained is less than or greater than the defined threshold, we get to know whether the water is acidic or basic, conductivity is high or low, is the water pure or impure and hence if it is suitable or not for the specific purpose.

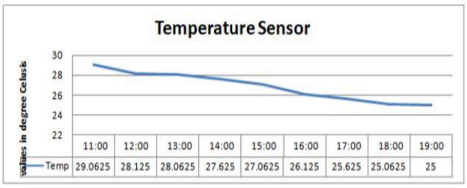

Fig.5 Snapshots of GUI of results displayed on PC.

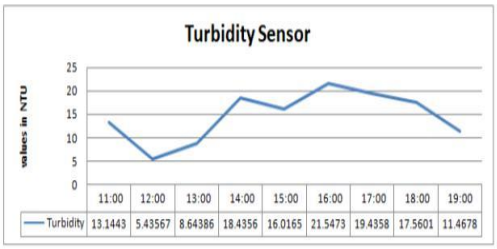

Fig. 6 Snapshots of GUI of results displayed on PC

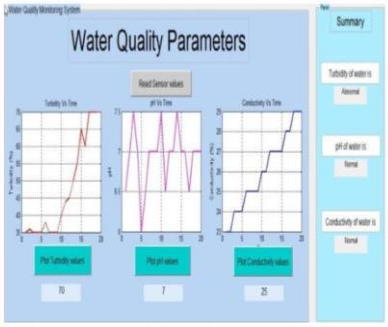

Fig.7 Snapshots of GUI of results displayed on PC

VI. CONCLUSION

The paper addresses about developing an efficient wireless sensor network (WSN) based water quality monitoring system and water pollution can be easily detected by this system, which will help in controlling it. Overall the proposed execution of high power Zig bee based WSN for water quality monitoring system offering low power utilization and low cost is presented. Another important fact of this system is the easy installation of the system that is the base station can be placed at the local residence close to the target area and the monitoring task can be done by any person with very less training at the beginning of the system installation. Performance modeling is one important aspect in different environment to be studied in the future as different kind of monitoring application requires different arrangement during system installation.

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