Real Time Water Quality Monitoring Using WSN

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Abstract— The application of wireless sensor network (WSN) for a water quality monitoring using high power RF communicating ends offer highly reliable real time system that helps in preserving the vital natural resource. It is composed of a number of sensor nodes with a networking capability that can be deployed for an adhoc or continuous monitoring purpose. The parameters involved in the water quality determination such as the pH level, turbidity and temperature is measured in the real time by the sensors that send the data to the base station or control/monitoring room. In this work, the fundamental design and implementation of WSN featuring a high power transmission Bluetooth based technology together with the IEEE 802.15.4 compatible transceiver is proposed. The use of wireless system for monitoring purpose will not only reduce the overall monitoring system cost interms of facilities setup and labour cost, but will also provide flexibility in terms of distance or location. The developed platform is cost-effective and allows easy customization. Several preliminary results of measurement to evaluate the reliability and effectiveness of the system are also presented.

Keywords—WSN; Sensors; Real Time; Bluetooth.

I. INTRODUCTION

Extensive research, invention, globalization and developments are taking place but there are also potential environmental threats like pollution, global warming resulting in damage to nature and its habitants. Water is the essential natural resource of life for each living organism on the earth. The vital factor of all living beings, water is polluted the most. There is no safe drinking water for human being. In the developing countries because of lack of proper water treatments and technologies the dirty & polluted water is used for drinking purpose. The lack of water quality measuring systems results in poor health conditions. Health condition of human, plant and other living organisms on the earth depends on water quality. In examining quality of water parameters like pH level, turbidity effective steps for safe water supply shall be made. This system measures water quality through various parameters by using wireless communication providing quality control, record keeping and analysis.

This work started after considering the critical situation of the polluted natural water resources. Keeping our water resources so that it is always within a standard determined for domestic usage is a crucial task. 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 due to limitation especially in manpower, facilities and cost of equipment. This often lead to J. Abinaya

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a too late to be handled situation. For that, it is important to have such a monitoring system with characteristics of autonomous, lower cost, reliable and flexible. The use of automation in monitoring task will reduce the reliance on manpower at the monitoring site thus reducing the cost. This project focuses on the use of multiple sensors as a device to check the level of water quality as an alternative method of monitoring the condition of the water resources. Several sensors that are able to continuously read some parameters that indicate the water quality level such as chemical substances, conductivity, dissolved oxygen, pH, turbidity etc will be used to monitor the overall quality level. As the monitoring is intended to be carried out in a remote area with limited access, signal or data from the sensor unit will then be transmitted wirelessly to the base monitoring station. Popular and widely used technology based on wireless sensor network is extensively used in this project as it is able to provide flexibility, low cost implementation and reliability. A high power transmission with a relatively low power consumption Bluetooth based wireless sensor network technology is applied in this work. Bluetooth is a communication standard for use in the wireless sensor network defined by the Bluetooth that adopting the IEEE 802.15.4 standard for its reliable communication. It is chosen due to its features that fulfill the requirement for a low cost, easy to use, minimal power consumption and reliable data communication between sensor nodes. The development of graphical used interface (GUI) for the monitoring purpose at the base monitoring station is another main component in the project. The GUI should be able to display the parameters being monitored continuously in real time. Several measurement and performance analysis to evaluate the reliability, feasibility and effectiveness of the proposed monitoring system are also presented. This work started after considering the critical situation of the polluted natural water resources. Keeping our water resources so that it is always within a standard determined for domestic usage is a crucial task. 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 due to limitation especially in manpower, facilities and cost of equipment. This often lead to a too late to be handled situation. For that, it is important to have such a monitoring system with characteristics of autonomous, lower cost, reliable and flexible.

SYSTEM STUDY

Existing system

Existing system shows that the problem result of the sensor is frequently monitored by human being onsite.

- Use of sensors like PH, Rain Detector, Turbidity sensor and measured manually.
- Uses the wired sensor networks.

Disadvantage

- The sensors and monitoring system input source is high.
- Human error occurs like misbehave (or) wrong report to higher officials by labour.
- Overall cost is high

Proposed system

- Real time support is provided by the proposed wireless sensor network (WSN) based system and the result will be sensed and transmitted by the Bluetooth device
- WSN is used to measure pH, temperature, turbidity and quantity of water using sensors at remote area using Microcontroller.
- System derives power to sensor nodes using solar energy. It collects data from various sensor nodes and sent to base monitoring station by wireless system.

The system data cached by ANDROID Application.

- WSN technology provides us approach to real time data acquisition, transmission and processing
- Low power consumption, long battery life, reduced time and manpower.
- No carbon emission, more flexible to deploy at remote site
- It provides easy installation where the base station can be placed at the local residence close to the target area and the monitoring task can be done by and person with minimal training.

II. SYSTEM ARCHITECTURE

Water is essential resource of life for each living organism on the earth. Oxygen level in water plays important role in examining quality of water. Water quality plays important role in the health issues of human, plant and living organisms on the earth. Generally, main sources of water are rain, rivers and lakes. Rain water running over the lands contains many useful as well as harmful contents, may be soluble or insoluble. Acidity of water is decided by the salt and particles in soil. Traditional measure of water quality is transparency of water that means insoluble particles mixed in water degrades usefulness of water for particular application.

The main aim is to measure the ph level, temperature, rain detector, pressure and water level as well as water that may be used for agriculture and industrial processes. The remote access of water quality measurement parameters using wireless communication facilitates quality control, record keeping and analysis using simulation software at base station. Oxygen level, pH and turbidity level are the parameters that are analyzed and to improve water quality.

Following are the objectives of the system.

• Measurement of pH level, temperature, rain detector, pressure and water level of water using available sensors at remote place.

• To avail local power supply to sensor nodes using solar energy.

• To collect data from various sensor nodes and send it to base station by wireless channel.

• To control data communication between source and nodes.



IV. HARDWARE DESIGN

The modules of the system includes

- 1. Sensing
- 2. Controlling
- 3. Interfacing
- 4. Communication

4:1. Sensing

Sensing is a data monitoring node. A sensor is a device that detects and responds to some type of input from the physical environment.

Data Monitoring:

The data monitoring nodes which consist of sensors (Ph, Temperature, Rain Detector, Pressure, Water level), signal conditioning circuit, a controller and RF module. The data sensed by the sensor will be passed through a signal conditioning circuit in order to manipulate the analog signal in such a way that it meets the requirements of the next stage for further processing. Then the manipulated data will be given to the controller (ATmega328P). The inbuilt ADC will convert the analog signal to digital signal for further processing. With the help of the RF module the manipulated sensed data will be sending to the data base station.

To monitoring live parameter changes in water (river, pond etc.,) We use following five sensors

- 1. PH Sensor
- 2. Temperature sensor
- 3. Rain Detector
- 4. Pressure sensor
- 5. Water level sensor

The result of the above sensors is verified by using microcontroller with predefined parameters.

1. PH Sensor

This sensor is to measure hydrogen-ion activity in water based solutions ,This sensor having two electrodes namely:

- 1. PH electrode
- 2. Reference electrode

Microcontroller reads potential difference between these two electrodes by using controller. Controller verifies the value with predefined parameters and said which it is acidic or alkaline.

A pH value is a number from 1 to 14, with 7 as the middle (neutral) point. Values below 7 indicate acidity which increases as the number decreases, 1 being the most acidic. Values above 7 indicate alkalinity which increases as the number increases, 14 being the most alkaline.

2. Temperature Sensor

Temperature sensor is used to monitor the temperature level of the water. System uses a thermometer to measure the surface water temperature. The water temperature at the deepest part of the pond can be measured using a thermometer attached to a weighted rope. Lower the devices until it is just off the bottom and leave it suspended there for approximately 5 minutes.



3. Rain Detector

It is used to detect rain falling status that result of the sensor is monitored by using microcontroller. If rain fall detects it give high pulse |(+5v) to the microOcontroller. Otherwise give low pulse to the controller.



4. Pressure sensor

It is used to measure water pressure. The pressure sensor works by converting pressure into an analogue electrical signal. Pressure transducers have a sensing element of constant area and respond to force applied to this area by fluid pressure. The force applied will deflect the diaphragm inside the pressure transducer. Water pressure is monitored by using microcontroller. With predefined parameters.



5. Water level sensor

Water level sensor to sense available water level. The sensor having 3 electrodes with reference electrode. The 3 electrodes are used to measure water level in percentage by using our controller programming.



4:2 Controlling

The project is designed by using Arduino Uno (Data Base station) board for controlling the device with Bluetooth, which is remotely controlled and operated by an Android OS smart phone.

Data Base station:

The data from all the nodes is collected at the data base station consisting of microprocessor (Arduino Uno). 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 Bluetooth Module.



The word controlling is referred as microcontroller. We did embedded c program to monitor water quality and that result is forwarded to Bluetooth. Here, sensors are the input source. Output-1 is referred as LCD Display. Output-2 is referred as Bluetooth(HC-05).

4:3 Interfacing

An interfacing which is used to connect various peripherals to carry out various operations to get a preferred output.

Here, level converter is the interfacing device between controller and Bluetooth module. Microcontroller is TTL (Transistor-Transistor logic), Bluetooth is CMOS logic(RS232). So, direct communication between them because it cause to damage controller.





Remote Monitoring station:

The remote monitoring station consists of a Bluetooth 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 (GUI) via serial communication. 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. The data monitoring nodes which consist of sensors (Ph, Temperature, Rain Detector, Pressure, Water level), signal conditioning circuit, a controller and RF module. The data sensed by the sensor will be passed through a signal conditioning circuit in order to manipulate the analog signal in such a way that it meets the requirements of the next stage for further processing. Then the manipulated data will be given to the controller (ATmega328P). The inbuilt ADC will convert the analog signal to digital signal for further processing. With the help of the RF module the manipulated sensed data will be sending to the data base station .

Bluetooth SPP (Serial Port Protocol) module, designed for transparent wireless serial connection setup. The HC-05 Bluetooth Module can be used in a Master or Slave configuration, making it a great solution for wireless communication. This serial port Bluetooth module is fully qualified Bluetooth V2.0+EDR (Enhanced Data Rate) 3Mbps Modulation with complete 2.4GHz radio transceiver and baseband. It uses CSR Blue core 04-External single chip Bluetooth system with CMOS technology and with AFH (Adaptive Frequency Hopping Feature).

Here, Bluetooth is the communication between hardware and android mobile. The result of the controller will be forwarded to Bluetooth module. The wireless data received by android mobile with support of inbuilt Bluetooth module. We design an android application to view the result.

V. SYSTEM FUNCTIONALITY

- Sensor can sense through the microcontroller and the output will transmitted via wireless sensor network through Bluetooth.
- At Android, the sensor outcome data will be received via Bluetooth the expected outcome should be viewed in the android application.

VI. CONCLUSION

The system incorporates water quality monitoring emphasizing on the aspects of low cost, easy adhoc installation and easy handling and maintenance. It gives auto alerts if quality of water changes. It has additional feature to check the reading of water parameters and check weather water is suitable for consuming or not without having the expert knowledge.

The proposed system can be easily installed to different fields like society water resource, local water dams and other fields.

Hence it is very useful system for the places where it is not possible to take immediate action against health problems caused by quality of water.

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