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DESIGN AND IMPLEMENTATION OF AN EFFICIENT AQUA QUALITY MONITORING SYSTEM

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ABSTRACT
The system proposed in this paper is implemented for monitoring the quality and managing the quantity of drinking water using wireless sensor network. This is a mobile system design for usage in remote areas. This system generates an alarm in the wireless zone and hence helps in deciding the quality and quantity of water across the zone. In this system we attempt to deploy the sensors that monitor pH, Temperature, conductivity, purity, salinity and water flow. The signal conditioning circuit is also implemented in addition to the sensors. Temperature sensor is included for compensating its dependency on other parameters. The communication across the sensor nodes is done using the zigbee protocol.

Keywords: *Water quality Monitoring, Water quantity management. Sensors, remote monitoring, Wireless Sensor network.*

1. INTRODUCTION

Water quality is a measure of suitability of water for a Particular use based on the physical,chemical and biological Parameters. To know the water quality standards, firstly the water samples are collected offline and desired parameters are measured and are compared to the numerical standards and guidelines for deciding the best suitability of water.Sensors are the ideal devices that solve such problems. Also sensors easily acquire data,process ,transform and control signals and provide certain advantages such as fast response,good selectivity and high sensitivity and so on. Our design is aimed to facilitate water quality monitoring and Controlling Water quantity management from remote locations with improved reliability and accuracy. The proposed WSN has been deployed to monitor the water distribution in our university campus using temperature sensor, pH sensor and electrical conductivity sensor and experimental results demonstrate the ability of the WSN to collect real time data, store them and display the on a website. As the monitoring is to be carried out in remote areas, signals from sensor units will be transmitted wirelessly to the base station. A high power transmission with a low power consumption zigbee communication is adapted for this work. Zigbee is a wireless technology developed as IEEE 802.15.4 standard to address the unique needs of low cost, low power wireless network. It operates in unlicensed band including 2.4GHz, 900MHz and 868MHz.

2. RELATED WORKS

Several studies on application of wireless sensor network for water quality Monitoring have been reported in[3].The design issues and implementation issues are discussed but not the sensor selection .The selection of sensors itself is a challenging task. The sensor selection was done according to the Controller and is discussed in [6] .The zigbee module application is found[11]and also its role in communication.

3. SYSTEM ARCHITECTURE

a. Sensor Unit

The sensors being used are temperature sensor DS18B20 pH sensor,electrical conductivity sensor and a water flow sensor. DS18B20 is produced by U.S. DALLAS Semiconductor Company. It is a digital temperature sensor, using single-bus

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protocol. The testing temperature range is -55 ° C-+125 ° C, and the accuracy between -10 ° C~+85 ° C is ± 0.5 °. A pH probe with pH ranging from 0-14 (Na+ error at >12.3 pH),speed of response being 95% in 1 second and is potential point being pH 7.00 (0 mV) with +/- 0.20 pH and 38400 baud rate default.A conductivity electrode with measuring surface as Platinum coating with max temperature 0-70° C. Data output is a comma separated string µs, TDS, Salinity .Water flow sensor G3/4 Contains a plastic valve body,a rotor and a hall effect sensor which works with 5-24v and 15mAcurrent and ranges a flow from 1-60 L/min with a liquid operating temperature of <120 ° C to know the leak detection[5]. All the above sensors work from 5v to 12v range. The information sensed from the sensor is converted into an electrical signal and then passed through the signal conditioning circuit that converts the voltage in between 0 to 2.4 volts produced by the sensors proportional to the actual parameters being sensed. These outputs are given to the adc channels of the microcontroller that processes it to human understandable values.

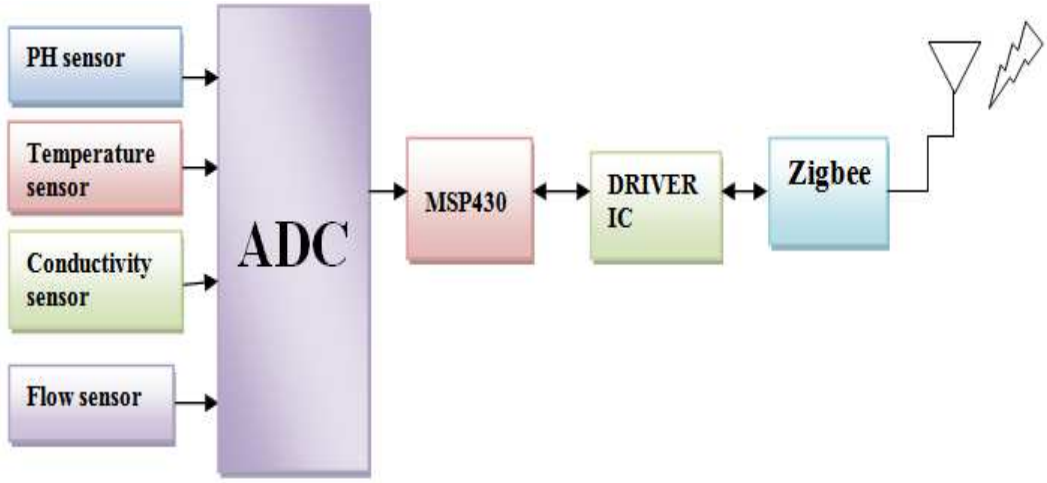

Figure 1.Block Diagram of the System

b.Wireless Sensor Node

The WSN consists of nodes from few several hundreds or thousands and each node is connected to one or more sensors .It consists of a sensor unit as mentioned in the above section. a microcontroller, a radio transceiver for communication , and an electronic circuit for interfacing with the sensors[3]. All of them share the single battery as a power source.The microcontroller used is MSP430F5438.The zigbee module used is CC2430[1]transceiver IC
From Texas instruments that comply to IEEE 802.15.4 standards with maximum power Transmission of 100mW. This transceiver IC is integrated with MSP430 with a low Power but a high performance flash memory[8]. The module requires 3.3 V dc supply and multiple sensor outputs with adc channels of MSP430,operating at 2.4GHz frequency with a configurable sleep mode to get the best of power consumption below 3uA.

Base monitoring station

It facilitates wireless communication between user equipment and network. The user equipments are mobile phones or computers with wireless internet connectivity.

Gateway node

It is a network point acting as an entrance to another network.A gateway node is often associated with both a router and a switch which helps to know where to direct a data packet.

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Zigbee station

The Zigbee coordinator node is embedded into the gateway as a fully functioning device that collects Data from all the sensor nodes[11]. Communication is done serially or direct communication with pc realizing Real time data check and monitor.

Web Data base server

It is responsible to set all the acquired data in the database and sets it according to the area code and then web server functions are provided. The user can visit it anytime through the specific terminal.

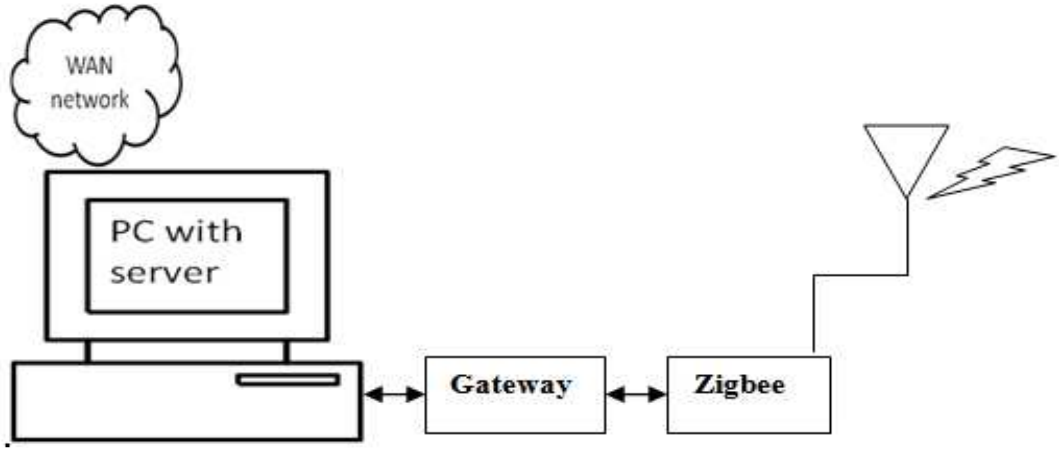

Figure 2.Sending Data from PC to Server

c. Interface schematic

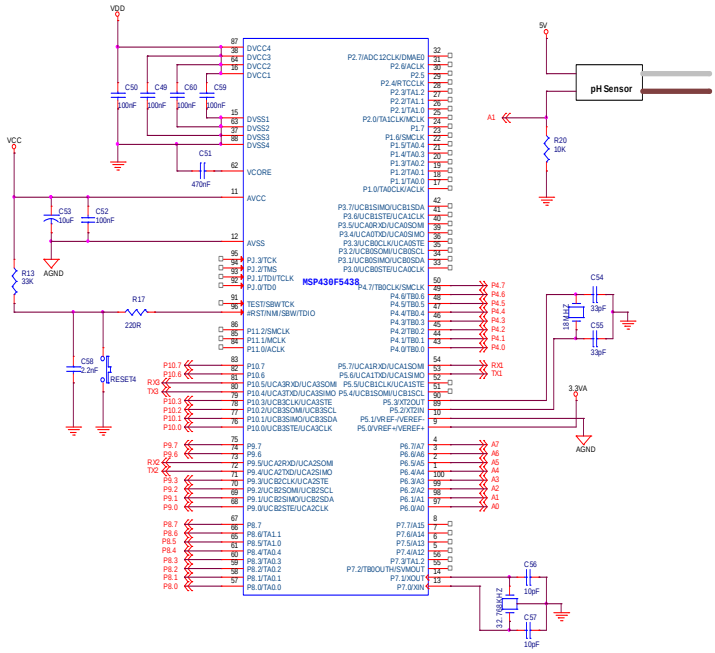

Figure 3 pH sensor interface schematic

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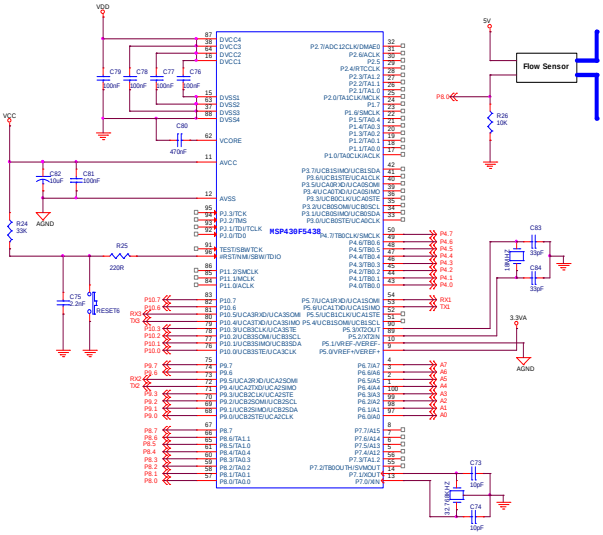

Figure 4 Flow sensor interface schematic

The figures a and b shows the interfacing of the pH and flow sensors to the processor. The A1 pin of pH sensor is interfaced to pin 97 and similarly one output of flow sensor is connected to pin 5.0 of MSP430F5438 and the ground pins of the sensors connected together. The zigbee module is placed on the slot provided on the board.

d. Software Design

The Code Composer Studio[7]is an Integrated Development Environment tool set for the development of embedded applications employing Texas MSP430 controller.It runs on both MS windows and Linux operated machines which is easy to use and include fast application development.
The flow diagram of the whole system with MSP430 being the master and its routine is as shown

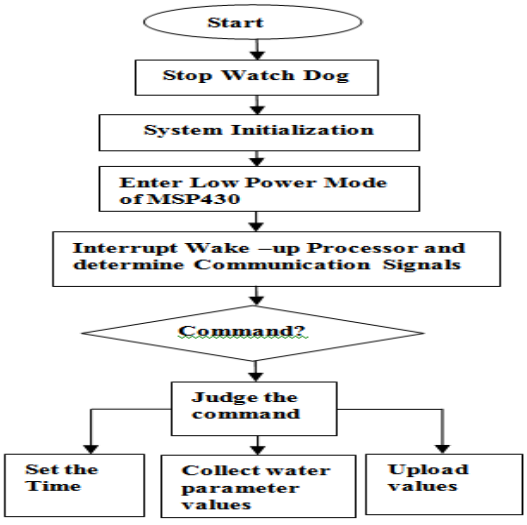

Figure 5 Flow chart of Processor Operation

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The operation of the main program of processor can be divided into five parts: (1) Setup the system, including initializing the clock, LED, KEY, RTC, Serial Port, ADC; setup the ZigBee module and switch off. (2) Processor goes into low-power-consumption mode and waits for the switch-off from the serial port. (3) The data input at the serial port will interrogate its breaking off and wake up the processor to resume normal working; it can also identify and operate the data at the serial port. (4) Decide whether the data received at the serial port is useful. If not, the processor shall return the low-power-consumption mode and keep on waiting for the serial port data; if useful, the processor shall decode and identify them and decide the content of the order. (5) As per the content of the order, by controlling the peripheral equipment, the processor sets up the time, measures the water parameters or uploads water quality parameters at a certain time. After the operation, the processor returns to the low power-consumption mode and waits for the data from the serial port.

4. PROTOTYPE IMPLEMENTATION

The figure shows the prototype developed and also the VB script that displays the page with water parameters on the screen. The purpose of this project is to read the analogue values from different sensors and transmit it to PC through Zigbee.

Fig 5.Prototype of the System with MSP430 and sensors

5. RESULT

The different sensor parameters that are remotely monitored using zigbee are being dispalyed in the PC terminal as shown below

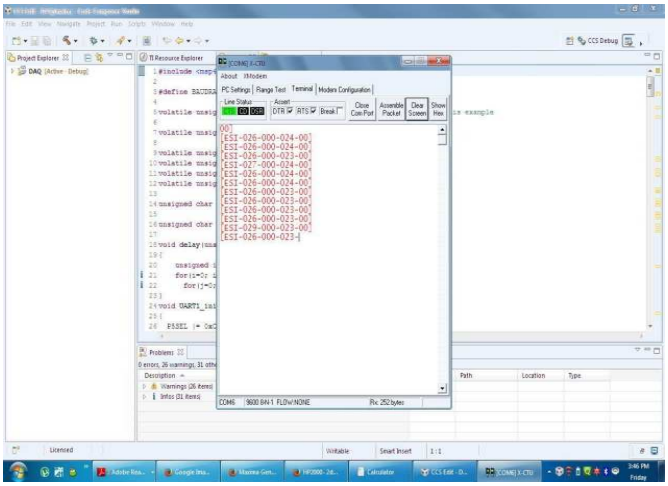

Figure 7.Terminal displaying various sensor parameters in the PC

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6 .CONCLUSION AND FURTHER WORKS

This paper explains water quality and quantity monitoring system using WSN with three main parts namely hardware and software of data nodes and base station and a software for remote monitoring. It presents us with a large monitoring area with a less cost and low power consumption .The future work can be established with more number of sensor nodes and also base station. The performance modelling in various environments can be an aspect of future research.

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