WATER ENVIRONMENT MONITORING SYSTEM BASED ON ZIGBEE TECHNOLOGY

Shruti M.Hamand[1]

[1] *student, Electronics and telecommunication Department, MCOERC, Maharashtra,*

ABSTRACT

The Zigbee network is used to monitor the environment parameters of aquiculture water. Each sensor node of the network, which is composed of various sensors pH value, content of ammoniacal nitrogen etc. A GPRS module is used to complete data exchanging between remote monitoring center and the wireless sensor network. This system is an application in acquiculture field. Through an algorithm based on neural BP network and D-S Evidence Theory, this system could diagnose the type of water environment parameter abnormity automatically. Wastewater treatment processes are concerned with controlling the energy efficient removal of pollutants in the smallest possible space in the shortest possible time. Required are Detailed knowledge of the underlying process, Highest possible transparency of the process steps through corresponding measuring methods. The efficient control of Nitrogen in wastewater systems is possible by making those measurements directly in the wastewater process. This not only ensures purification but above all guarantees economic operation of the entire plant.

Keyword: - *Sensor, SMS, GPRS*

1. INTRODUCTION

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 man power, 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. The use of automation in monitoring task will reduce the reliance on man power 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 remote area with limited access, signal or data from the sensor unit will then be transmitted wirelessly to the base monitoring station. A currently becoming 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 Zigbee based wireless sensor network technology is applied in this work. Zigbee is a communication standard for use in the wireless sensor network defined by the Zigbee Alliance that adopting the IEEE 802.15.4 standard for its reliable communication. It is chosen due to its features that fulfil the requirement for a low cost, easy to use, minimal power consumption and reliable data communication between sensor nodes.

2. PROPOSED SYSTEM

Hardware implementation of the proposed system is shown in fig 1 and fig 2 with transmitter end of the system and receiver end of the system.

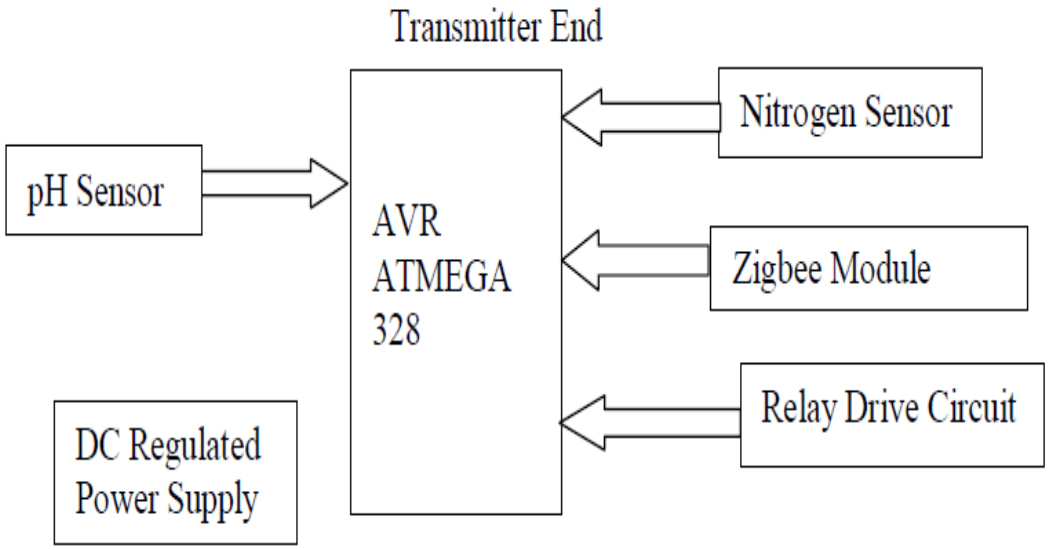

Fig -1: Transmitter End of the System

RECEIVER END

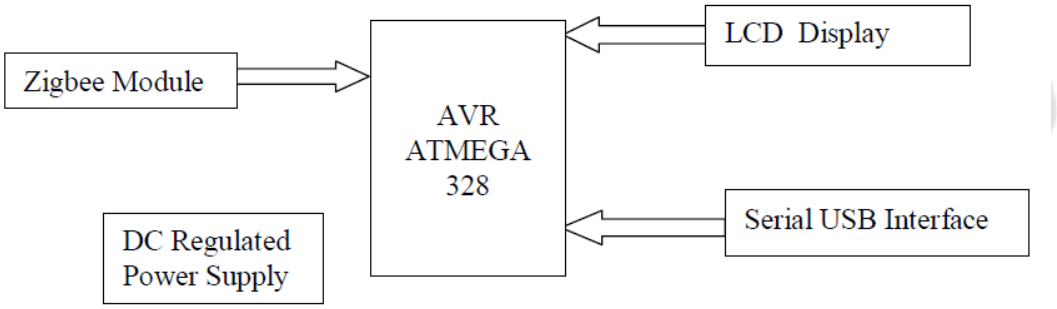

Fig-2: Receiver End of the System

2.1 Monitoring System

The system to be used for water monitoring comprises of the following:

2.1.1 PH Sensor:

Fig-3: Typical pH sensor

pH measurement has a wide variety of industrial applications in virtually every industry. These range from water conditioning to specific process related measurements to waste treatment. 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.

The transfer function of the pH electrode is:

$$pH(X)=pH(X)= pH(S) + \frac{(Es-Ex)F}{RT\ In(10)}$$

pH(X) is unknown solution(x),pH(S) is standard solution 7, Es-electric potential at reference or standard electrode, F is the faraday constant=9.6485309,R is the universal gas constant = 8.314510,T is temperature in Kelvin.

2.1.2 Nitrogen Sensor:

Nitrogen is found in a large variety of compounds and forms and is considered to be the ultimate "quick-change artist". In municipal wastewater it is mainly encountered as a waste product in the form of urea, which is already converted in part to ammonium nitrogen by ammonification. In the aeration basin, the initial step of nitrification consists in oxidizing the nitrogen present in wastewater via nitrite to nitrate, for which oxygen is required. During subsequent denitrification the nitrate (NO3–) is further converted to elemental nitrogen N2 under the absence of oxygen. This nitrogen in gas form is harmlessly released into the environment. The efficient control of Nitrogen in wastewater systems is possible by making those measurements directly in the wastewater process. This not only ensures purification but above all guarantees economic operation of the entire plant.

2.2.3 Zigbee Module:

ZigBee is a specification for a suite of high-level communication protocols used to create personal area networks built from small, low-power digital radios [5]. ZigBee is based on an IEEE 802.15 standard. Though its low power consumption limits transmission distances to 10–100 meters line-of-sight, depending on power output and environmental characteristics, ZigBee devices can transmit data over long distances by passing data through a mesh network of intermediate devices to reach more distant ones. ZigBee is typically used in low data rate applications that require long battery life and secure networking (ZigBee networks are secured by 128 bit symmetric encryptionkeys.) ZigBee has a defined rate of 250 kbit/s, best suited for intermittent data transmissions from a sensor or input device. Applications include wireless light switches, electrical meters with in-home-displays, traffic management systems, and other consumer and industrial equipment that requires short-range low-rate wireless data transfer. The technology defined by the ZigBee specification is intended to be simpler and less expensive than other wireless personal area networks (WPANs), such as Bluetoothor Wi-Fi.

2.2.4 DC Regulated Power Supply:

DC Regulated Power Supply of 5volt and 12 volt is used to supply power.

2.2.5 LCD Display:

16x2 LCD display is used to monitor and view the PH value of water.LCD (Liquid Crystal Display) screen is an electronic display module and find a wide range of applications. A 16x2 LCD display is very basic module and is very commonly used in various devices and circuits. These modules are preferred over seven segments and other multi segment LEDs. The reasons being:

LCDs are economical;

easily programmable;

have no limitation of displaying special & even custom characters (unlike in seven segments), animations.

A 16x2 LCD means it can display 16 characters per line and there are 2 such lines. In this LCD each character is displayed in 5x7 pixel matrix. This LCD has two registers, namely, Command and Data.The command register stores the command instructions given to the LCD. A command is an instruction given to LCD to do a predefined task like initializing it, clearing its screen, setting the cursor position, controlling display etc. The data register stores the data to be displayed on the LCD. The data is the ASCII value of the character to be displayed on the LCD. Click to learn more about internal structure of a LCD.

3. METHODOLOGY

3.1 pH Scale

A very important measurement in many liquid chemical processes (industrial, pharmaceutical, manufacturing, food production, etc.) is that of pH: the measurement of hydrogen ion concentration in a liquid solution. A solution with a low pH value is called an "acid," while one with a high pH is called a "caustic." The common pH scale extends from 0 (strong acid) to 14 (strong caustic), with 7 in the middle representing pure water (neutral):

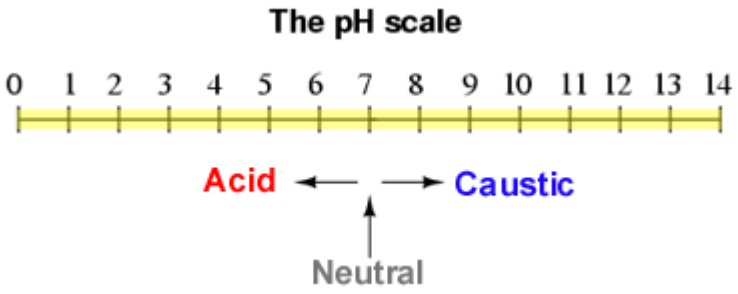

Fig- 4: pH scale

pH is defined as follows: the lower-case letter "p" in pH stands for the negative common (base ten) logarithm, while the upper-case letter "H" stands for the element hydrogen. Thus, pH is a logarithmic measurement of the number of moles of hydrogen ions (H+) per litre of solution. Incidentally, the "p" prefix is also used with other types of chemical measurements where a logarithmic scale is desired, pCO2 (Carbon Dioxide) and pO2 (Oxygen) being two such examples.

The logarithmic pH scale works like this: a solution with 10-12 moles of H+ ions per liter has a pH of 12; a solution with 10-3 moles of H+ ions per liter has a pH of 3. While very uncommon, there is such a thing as an acid with a pH measurement below 0 and a caustic with a pH above 14. Such solutions, understandably, are quite concentrated and extremely reactive.

3.2 Ammonia Detection Sensor NH3 Gas Sensor Module

Features:

- With the signal output LED indication
- 2-way signal output (analog output, and TTL-level output)
- TTL output valid signal is low; (low output signal light, which can be accessed microcontroller IO port)
- Analog output increases with the concentration, the higher the voltage the higher the concentration
- Ammonia has a high sensitivity and selectivity
- With a long life and reliable stability
- Fast response characteristics
- With mounting holes for easy permanent installation
- The probe can plug design for easy testing

3.3 Color Sensor

Color sensor systems are increasingly being used in automated applications to detect automation errors and monitor quality at the speed of production line. They are used in assembly lines to identify and classify products by color. The objectives of their usage include to check the quality of products , to facilitate sorting and packaging, to assess the equality of products in storage , and to monitor waste products [9]. Low cost and simple color sensors are preferred over sophisticated solutions for less demanding applications where the top priority is cost and power consumption.

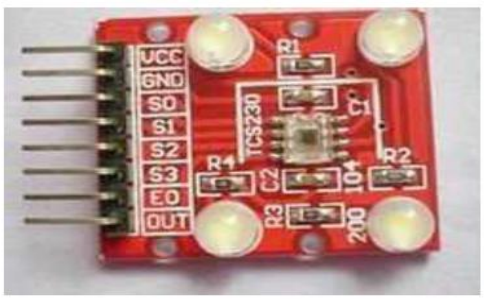

Fig-5:Color Sensor

This Color Sensor is a complete color detector, including a TCS230 RGB sensor chip and 4 white LEDs. The TCS230 can detect and measure a nearly limitless range of visible colors. Applications include test strip reading, sorting by color, ambient light sensing and calibration, and color matching. The TCS230 has an array of

photodetectors, each with either a red, green, or blue filter, or no filter (clear). The filters of each color are distributed evenly throughout the array to eliminate location bias among the colors. Internal to the device is an oscillator which produces a square-wave output whose frequency is proportional to the intensity of the chosen color.

4. RESULTS

	Distilled Water	Regular Water	Blackish Mud	ChemicalWaste
pH	7	8	8.5	6
Ammonia(ppm)	30	110	160	200
Turbidity	10	70	80	60

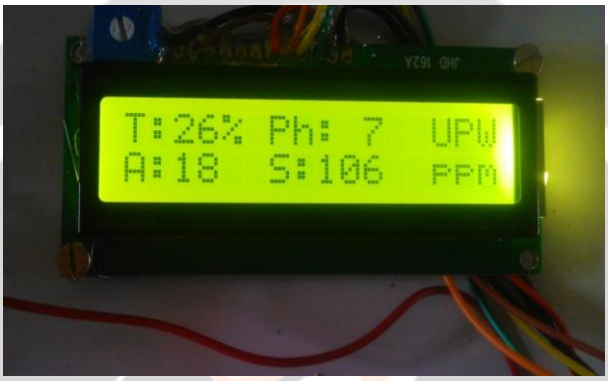

Fig-6:Simulation Result

5. CONCLUSION

The proposed implementation of high power Zigbee based WSN for water quality monitoring system offering low power consumption with high reliability is presented. The use of high power WSN is suitable for activities in industries involving large area monitoring such as manufacturing, constructing, mining etc. Another important fact of this system is the easy installation of the system where 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 minimal training at the beginning of the system installation. Performance modelling in different environment is one important aspect to be studied in the future as different kind of monitoring application requires different configuration during system installation.

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