

Design of Remote Water Quality Monitoring System Using PIC Microcontroller

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Abstract— Water is an intrinsic component in our day to day life and a valuable resource to human achievements. The idea of ‘Embedded Wireless Acquisition System’ is the prime building block of the water quality monitoring using wireless communication technology. This paper describes the work carried out to design the embedded wireless acquisition system that can collect the turbidity and the remote pH of the water. The system is built on the embedded platform of Peripheral Interface Controller (PIC) microcontroller, which aims at designing of the low cost and low power water quality monitoring system with the vital use of RISC type controller. The system is divided into two sections as Transmitter section, that collects the pH and turbidity readings from remote place, and, Receiver section, that collects transmitted readings using the ZigBee wireless communication technology. The results are displayed on the LCD mounted on the Transmitter section over different time periods.

Keywords—pH level, Turbidity level, PIC microcontroller, ZigBee.

I. INTRODUCTION

With the lot of technological research and inventions over the decades, we are moving towards making our cities as the smart cities. hence the current era is said to be era of inventions, era of development, era of globalization and the lot much else, but the contrast of the same is nothing but the current era is era of the pollution, global warming, insecurity and helpless health factors. One of the vital and basic obstruction is world's population does not have pure and safe water for drinking. The situation is even worse in some developing countries like in India, where dirty or turbid water is being used for drinking without any proper water treatment before drinking. The reasons for this happening are the ignorance of public & government sector and the lack of water quality monitoring system, which results in serious health issues.

The motivation came into the mind that a wireless system should be designed in order to monitor water quality in simplest and easiest way. This system can analyze some vital

and worrisome factors of water so that preventive actions can be taken for water quality maintenance. The pH sensor and turbidity sensor are used to collect the pH and turbidity level into the water [1][4]. Using the ZigBee technology, the users can get the data from the remote areas. The sensors are interfaced to the analog input of the PIC microcontrollers and the data collected from these sensors are transferred through the ZigBee [2][3]. At the receiver section the real time data is displayed on the LCD.

II. SYSTEM ARCHITECTURE

Water is one of the basic requirements for life of each living organism on the earth. pH level in water plays vital role in determining quality of water. Water quality plays vital role in the health issues of human beings, plant and living organisms on the earth. Especially, the main sources of water are rain, rivers and ponds. Rain water running over the lands contains many purities and impurities that may be soluble or insoluble. The main aim is to measure the pH level and turbidity in the drinking water as well as in the sewage water from industries that are driven into the rivers and also the water used for agriculture.

pH level and turbidity level are the parameters that are used to determine the quality of the water.

The objectives of the system are given below:

- To design the wireless water quality monitoring system.
- To measure the pH level and turbidity level using the sensors at remote place.
- To transmit and collect data from remote place to the receiver section using the ZigBee communication protocol.
- To display the real time data on LCD

III. HARDWARE SPECIFICATIONS

This part is going to discuss the detailed design of the system specifications

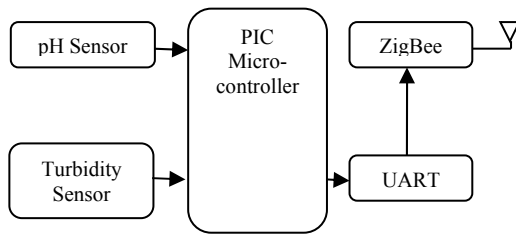


Fig 1: Block Diagram of Transmitter Section

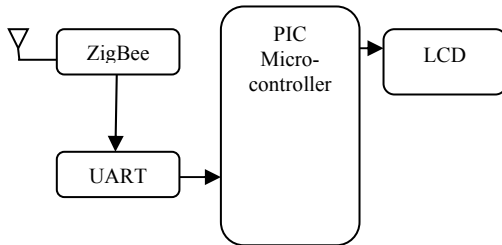


Fig 2: Block Diagram of Receiver Section

A. pH Sensor

The pH probe SEN0161 is used as the pH sensor with the BNC connector. When dipped into the solution, it provides the output voltage in millivolts with respect to the hydrogen ion concentrations in the solution. The output voltage range is from -414mV to +414mV with the operating temperature range of 0-60 degree Celsius. It has the accuracy of 0.01ph. The output voltage is positive for the acidic solution and negative for the alkaline solution. For neutral solution it gives zero output. The output pH range for SEN0161 is from 0 to 14. The pH sensor v1.1 is used as the signal amplification circuit to boost the output from mV to volts.

B. Turbidity Sensor

The TSW-10 module is used as the turbidity sensor. The TSW-10 module measures the turbidity (amount of suspended particles) of the water in river, lakes etc. An optical sensor is a measuring product for a turbid water density or an extraneous matter concentration using the refraction of wavelength between photo transistor and diode passed through a sample of water, the amount of light transmitted through the sample is dependent on the amount of soil in the water. As the soil level increases, then amount of transmitted light decreases. The turbidity sensor measures the amount of transmitted light to

determine the turbidity of the water. Its operating voltage is 5V with the operating temperature range from -10°C to 80°C.

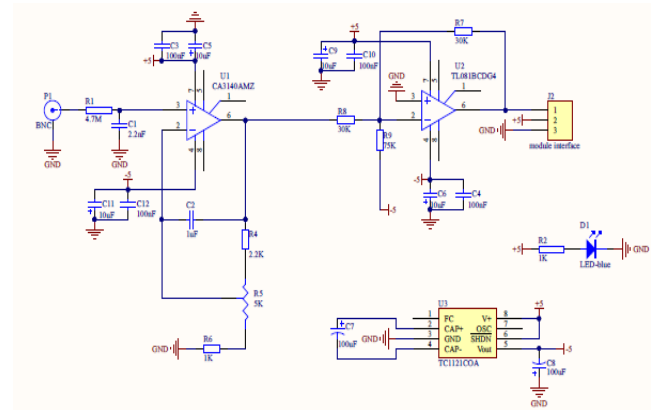


Fig 3: pH Sensor Interfacing Circuit

C. ZigBee Module

A wireless technology like ZigBee works on standard IEEE 802.15.4 protocol & operates on unlicensed bands worldwide at the frequencies 2.400-2.484GHz, 902-928MHz and 868.0-868.6MHz. The XBee Series 2 OEM RF Module is used in the system for the wireless transmission of the remote data. It is a high performance, Low cost, low power and easy to use RF module. It has the communicating range of up to 40m for indoor and 120m for the outdoor line-of-sight. It has the transmitting power of 2mW and receiver sensitivity of -95 dBm with the serial interface data rate of 250,000 bps. It requires a supply voltage of 2.8-3.4V with operating temperature range from -40 to 85° C.

D. PIC Control

The system is designed on the embedded platform of Peripheral Interface Controller (PIC) microcontroller. Both the sensors and the Xbee module are interfaced to the PIC microcontroller. The sensor inputs are given to the analog input of PIC and the Xbee is interfaced using the UART serial communication protocol. The Microchips PIC18F4520 PIC microcontroller is used, as it provides operating voltage of 5V and supports SPI, I2C and enhanced USART communication protocol.

IV. SYSTEM FLOW DIAGRAM

The software flow for the given system is given in three approaches as data collection, data transmission and display of

data. The decision of the water quality is decided based on the different pH level and Turbidity levels taken from the remote areas. The decision is made whether the water is clean and drinkable or not. The flow graph is given in Fig 4.

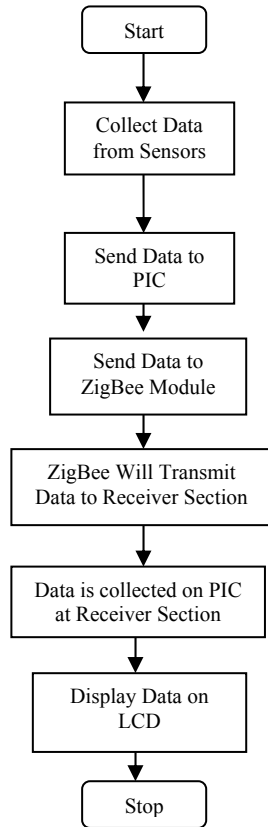


Fig 4: Software Flow Diagram

V. RESULTS

TABLE I. RESULTS

PH LEVEL	RESULT	TURBIDITY LEVEL	RESULT
5	WATER NOT DRINKABLE	3.0	WATER VERY DIRTY
6	DRINKABLE WATER	4.0	WATER VERY DIRTY
7	DRINKABLE WATER	5.0	WATER MILDLY DIRTY
8	DRINKABLE WATER	6.0	WATER NORMALLY CLEAN

9	WATER NOT DRINKABLE	7.0	WATER NORMALLY CLEAN
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CONCLUSION

The system provides the wireless water quality measuring tool with remote data collection. The data is collected at the receiver section and depending on the pH level and turbidity level, the data are classified and water quality is decided. The pH level of water ranging between 0 to 6 is called as the acidic, while the between 8 to 14 is called as the alkaline. The water with the pH value 7 is called as the Neutral solution. The water with pH 6 to 8 is preferably drinkable water as per the WHO report. If turbidity level is less than 5.0NTU, then it is a dirty water and for 6.0>, it is a clean water. The system measures the pH level and the turbidity level of the water from the remote areas, sometimes which is inconvenient to collect. The system can be implemented at the on-site areas like Rivers and lakes to determine the pH and Turbidity level, which is used for the drinking and agriculture purpose. In Smart Cities, the big housing societies provide the direct drinking water, which is stored in the tank at the top of building. The system can predict the drinkable water quality and displays the readings on the LCD, which can be mounted inside the individual home. Also it can be implemented in the chemical plants, where the sewage water is driven into the Rivers and lakes. We can predetermine the water quality, before driving it into Rivers and lakes, to avoid the water pollution.

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