IJARCCE

ISSN (Online) 2278-1021
ISSN (Print) 2319 5940

*International Journal of Advanced Research in Computer and Communication Engineering*
*Vol. 5, Issue 4, April 2016*

# Water pollution detection system using pH and turbidity sensors

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**Abstract**: Water pollution is one of the key threats which affect the life of citizens residing in a country as well as plants and organisms living inside water bodies. As we know water covers 70 percent of the earth's surface it is our responsibility to keep water clean. The main cause of water pollution is due to disposal of industrial waste into the river. The same water is utilized by citizens of that area. Since it is polluted it causes adverse effect on a citizen's life. So polluted water needs to be detected. The parameters involved in the water pollution detection like pH value and turbidity are measured in real time with the help of sensors. pH is an important parameter to determine the nature of water , whereas turbidity is also an equally important parameter since it causes adverse effects on aquatic ecosystems**.** Here we propose a water pollution detection system by taking into consideration various aspects like cost, easy setup and easy handling. In this paper we propose design and implementation of water pollution detection system using pH and turbidity sensors.

**Keywords**: Water pollution, pH, turbidity, sensors, ecosystems.

## I. INTRODUCTION

Natural water resources get polluted due to various reasons. Industrial waste is one of the major problems for citizens residing in that locality. There are many ways to detect polluted water in a stationary lab by means of chemical test or any other laboratory test. Further one can place testing equipment in the source of water and detect the polluted water remotely. In order to reduce hazards to citizen's life, it is necessary to check the quality of water before supplying it to every individual. The World Health Organization says diarrhoeal diseases remain a leading cause of illness and death in the developing world[1]. pH and turbidity are important parameters that we need to consider as far as water pollution is concerned. Turbidity is an indicator about the amount of suspended sediments present in water. In or proposed system we will consider three different criteria's for determining nature of water; i.e. whether water is normal, acidic or basic. Ideally pH value should be seven i.e. for normal water; which we consider as safe for utilization. Standards on the allowable turbidity in drinking water have been set by Governments. Ideally turbidity value should be zero. In the United States of America, systems that use conventional or direct filtration methods turbidity cannot be higher than 1.0 nephelometric turbidity units (NTU) at the plant outlet. Systems that use filtration other than the conventional or direct filtration have to follow state limits, which must include turbidity at no time exceeding 5 NTU[2]. There are several water quality standard methods and design standards in use[3 ].

## II. PROPOSED SYSTEM

Our proposed system consists of following entities:

*A. Water quality detection sensors:*
Here we have used pH and turbidity sensors.

*i. pH sensor*
pH sensor senses pH which is a measure of the acidity or basicity of aqueous solution, here the solution is water. It is measured by the tactic of electrical potential. Pure water is neutral and its pH should be equal to 7. If it is less than 7 then water is acidic or if it is greater than 7 then water is treated as basic or alkaline.[4] pH electrode that we have used in our system is shown below in figure 1.

**Figure 1: pH electrode**

*ii. pH meter:*
pH meter is nothing but precise voltmeter which is used to measure voltage of the pH electrode. Most commercially available voltmeters restrict their use since internal resistance of pH electrode is very high. In order to precisely measure voltage, voltmeter must have internal resistance at least 100 times larger, while most digital meters available have resistance in the range of 1-10 MΩ. Thus they are unsuitable[5]. Careful selection of op-amp is most important while building pH meter circuit. Here we have created an amplifier using op-amp IC TL081 since it has very high gain and very high input impedance. Switches and resistors in the circuit are necessary for calibration of pH electrode. The figure of pH meter is shown below in figure 2.

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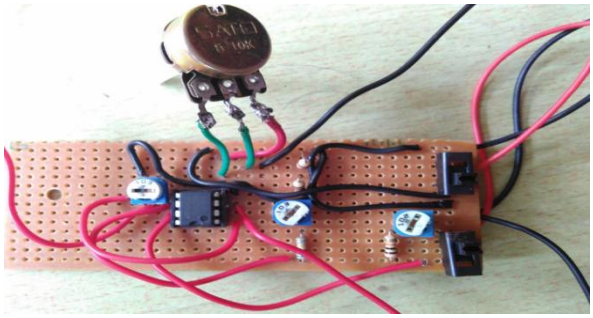

**Figure 2: pH meter**

*iii. Turbidity sensor*

Turbidity is an important parameter while measuring quality of water. High turbidity has various adverse effects on aquatic ecosystems. It includes: decrement in the amount of light penetration or sometimes blocking sunlight which inhibit photosynthesis thereby limits plant growth, erosion which reduces habitat quality for fish and other organisms and reduce the ability of fish and birds to find food [6]. High turbidity means high concentration of suspended solids, which can harm fish and other aquatic habitats. Turbidity sensor that we used in our system is shown below in figure 3. Here we have used LED as light source. When we put pot filled with clear water in between LED and photo diode, full light will pass through pot thereby it will break junction of the photo diode, which makes transistor fully on, thus producing output equal to zero which is given to the ADC of PIC controller, i.e. we can say turbidity value in this case equal to zero. On the other hand when we put pot filled with turbid water in between LED and photodiode, less light will pass through pot thereby it will increase transistor collector voltage which in turn increases value of turbidity.

**Figure 3: Turbidity sensor**

*B. PIC microcontroller:*

Here we have used 16F887A PIC microcontroller as it is self-reprogrammable under software control and it has power saving sleep mode. Other features include: selectable oscillator option and 10-bit, 8-channel Analog-to-Digital converter. Output of pH and turbidity sensors is applied to the ADC of PIC microcontroller, which in turn displays results of pH and turbidity parameter values on LCD, which is interfaced at one of the ports of PIC.

*C. Power supply unit:*

Power supply, clock and reset are the three important things that are needed for PIC controller. Since 5V supply is necessary to drive PIC microcontroller we have to use power supply unit which is responsible to provide fixed 5V supply to PIC. This unit consists of step-down transformer, bridge rectifier, filter, voltage regulator, power supply indicator LED and current limiting resistor. Step down transformer converts 230 volts a.c. to 12 volts a.c. supply which is further converted into 12 volt d.c. using bridge rectifier and filter circuit. The next component of this unit is voltage regulator IC. Here we used 7805 IC in order to provide fixed positive 5V supply. With the help of crystal oscillator and capacitors we can apply clock to the PIC controller and with the help of reset switch we can reset PIC controller. Figure 4 shows power supply unit along with clock and reset facility provided to the PIC controller.

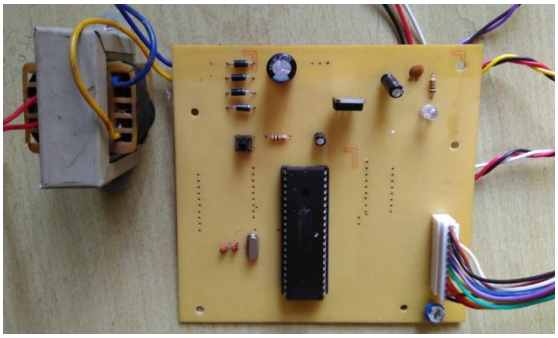

**Figure 4: Power supply unit**

The block diagram of proposed system is shown below in figure 5. It consists of all entities that are described above. The output of the pH electrode and turbidity sensor is applied to the ADC of PIC controller. Depending upon the value of pH and turbidity output will be displayed on LCD.

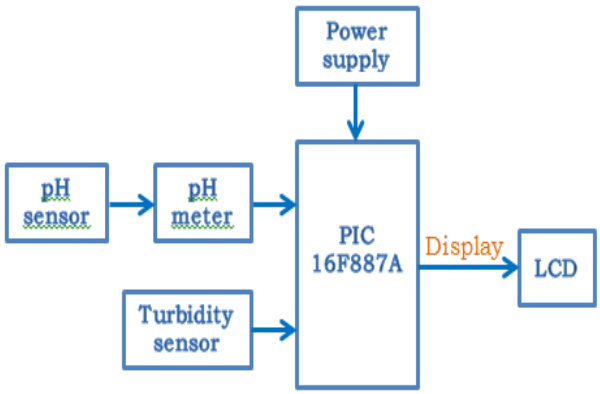


**Figure 5: Block diagram of proposed system**

## III.SOFTWARE DESIGN

Programming is done by using PIC simulator IDE. Operation of pH and turbidity value detection is shown below with the help of flow chart. Depending upon pH value of sample water result will be displayed on LCD, which is interfaced with 16F887A PIC. Buzzer will be "ON" or "OFF" depending upon the detected value of pH.

If pH is equal to 7 then buzzer will be "OFF" indicating neutral water or else buzzer will be "ON" indicating water is either acidic or basic. Same logic is used for turbidity, if its value is in between 0 to 5 then buzzer will be "OFF" indicating acceptable value for utilization of water or else buzzer will be "ON" for turbidity values greater than 5.


DOI 10.17148/IJARCCE.2016.54132

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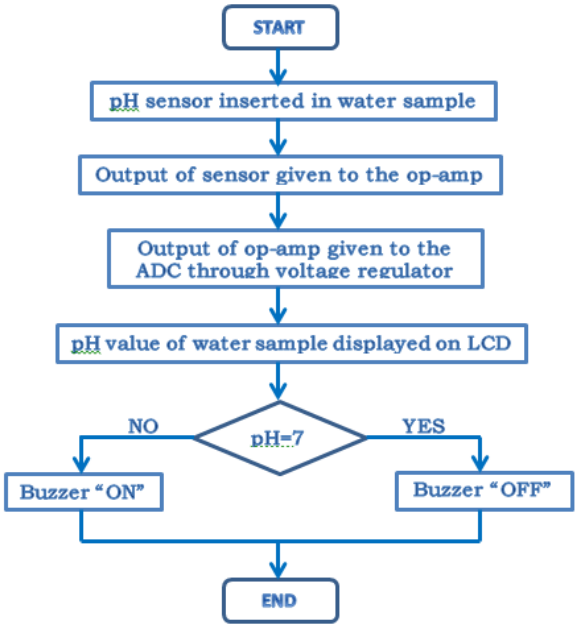


**Figure 6: Flow chart showing operation of pH sensor**

## IV. IMPLEMENTATION AND RESULTS

We implemented proposed system for detection of polluted water. We collected various results for different values of pH under different scenarios i.e. by using different types of water samples (neutral, acidic and basic). For neutral water we get pH=7, for acidic and basic water we get pH values less than and greater than 7 respectively. Different results for pH are shown below in the figures 7, 8 and 9.

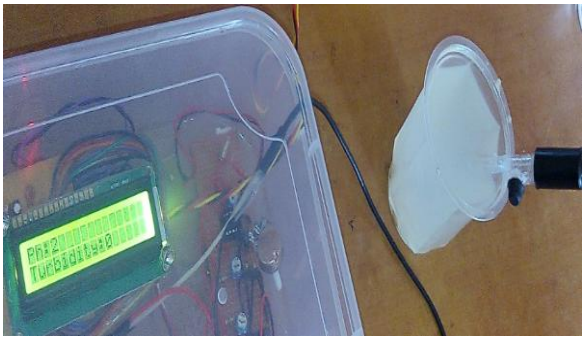

**Figure 7: pH=2 indicate acidic water**

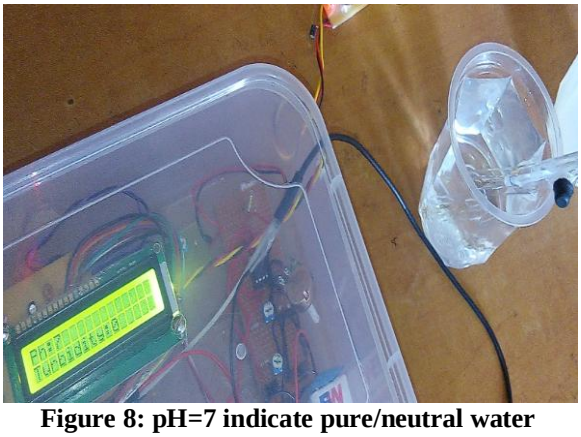

**Figure 8: pH=7 indicate pure/neutral water**

Similarly for clean and turbid water we get values for turbidity equal to 0 and greater than 0 respectively. Depending upon the presence of suspended particles we get variation in the results for turbidity values. Different results for turbidity are also shown below in the figures 10 and 11. For more turbid water we get turbidity value equal to 8.

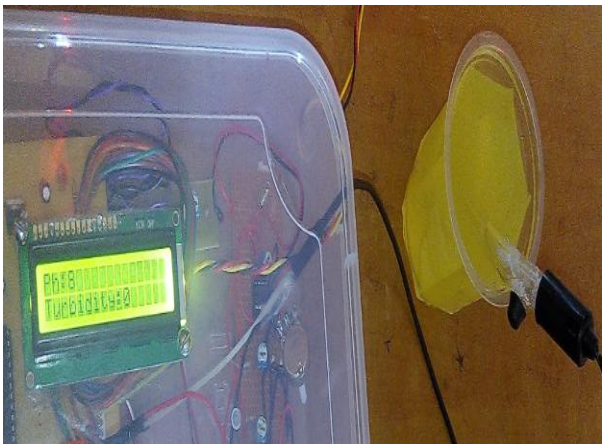

**Figure 9: pH=8 indicate basic water**

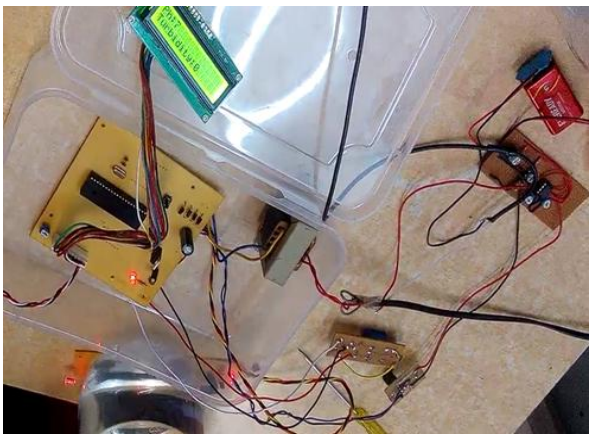

**Figure 10: Turbidity=0 indicate safe water**

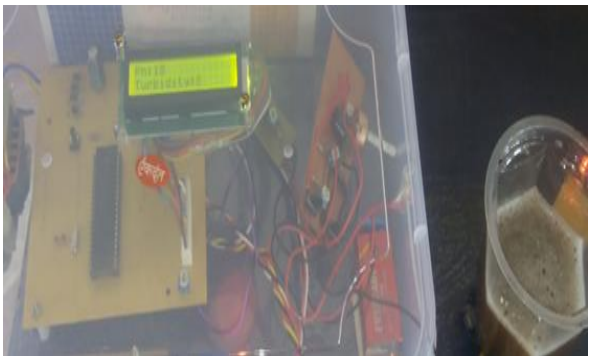

**Figure 11: Turbidity=8 indicate unsafe water**

## V. CONCLUSION AND FUTURE WORK

This paper presents water pollution detection system using pH and turbidity sensors. Water quality data is collected by pH and turbidity sensors and given to the 16F887A PIC microcontroller. Depending upon the nature of water pH and turbidity values are displayed on LCD. In future we


DOI 10.17148/IJARCCE.2016.54132

can build a system that can communicate the status of the water quality using GSM through smart phones.

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