



Sensor Based Electronics System for Evaluation of Water Quality

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Abstract

Quality of water is very important aspect in human life. Water may be impure or may contain several types of impurities and it may also contain salt or acidic materials. The presence of salt causes the water to become hard and this hardness of water causes the further process to deteriorate. This research presents a model to measure the hardness of water before sending it for further process. The tested water if contains unwanted impurities may be passed through various chemical process to make it pure and then being used is not hard and harmful, thus resulting in better efficiency in the various applications of water. This research is present a suitable model for water quality testing by checking pH level in different water sample using pH sensor circuit.

Keywords: Water quality, drinking water, quality testing, sensor, hardness, pH.

Introduction

Assurance of drinking-water quality and safety is a foundation for the prevention and control of waterborne diseases. It is very important task for health and security center to monitor and control the quality of drinkable water. As the drinkable water always required of good quality when get from the purification unit, but due to number of impurities and infections, the water becomes impure in the way of transformation. Also, water sometimes contain high amount of salt or acidic components which can further deteriorate the process of industrial applications. Therefore we need a simple; sensor based electronic system that is used to check the infection presents in water, to ensure the quality of water.

We need to measure the quality of the water by ensuring the appropriate pH, transparency level; salinity levels. This setup involves visual inspection of quality of drinking water by measuring important parameters. The electronics system measures the conductivity of water samples containing several types of impurities and use to determine the purity of water, which we may use at a later stage.

pH calculation is essentially the measurement of the number of hydrogen ions present in the testing sample and is usually expressed in the logarithmic scale. A pH sensor commonly consists of two electrodes which provide a linear potential response over a wide range of pH values. During the water spoilage process, the pH profile changes due to the growth and metabolic actions of microbes. The pH level can therefore provide an accurate indication of the freshness of the water product¹.

Thus using this project on a large scale various types of infection present in the water can be detected and after testing

the water may be processed chemically to obtain pure and good water.

Objective of Research: The main objective of this research has been to design and develop a sensor based electronic system which can be used to test and monitor the quality of water.

The objective of this research is to design and develop a pH sensing device which can be embedded into packaged material to test the quality of water.

The research work is carried out to design the model to study the various condition of testing water containing various types of infections and analyze the hardness of the water under test.

Methodology

Experimental Setup for Hardness Testing: The electronic system is designed using performance detecting sensor, PIC Microcontroller, voltage regulator circuit, monitoring display system and testing panel.

The testing panel has four test tubes of infected sample water as described below, i. 1st tube contains water in its purest form, i.e. distilled water which is used in batteries for vehicles. ii. 2nd tube contains water which is regular in nature and used for daily drinking purposes. iii. 3rd tube contains water which has a small amount of salt in it, thus making it hard. iv. 4th tube contains water in its most impure form, i.e. it contains some amount of acid in it.

Sensing circuit is designed using two conducting electrode and these electrodes would be dipped in the solutions of water samples. Inside the water solutions, these electrodes form the cathode-anode pair; certain amount of current will be generated.

The 1K ohm resistor connected to this sensor circuit which will oppose the flow of the current and thus potential difference occurs between the electrodes.

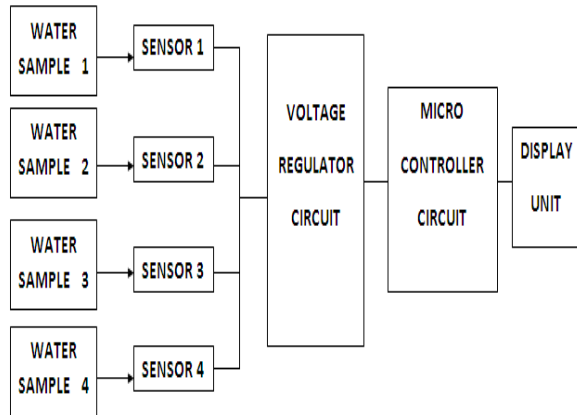


Figure-1
 Block diagram of water sensing model

The display unit gives the record of various performance parameters. The binary value is assigned for a wide range of voltage. In this analysis decimal value 0 indicates ground and 1023 for +Vcc. The output response of the system is proportional to the voltage across the sensing electrode of the testing panel.

The higher the value on display screen, better is the quality of water, and lower the value on screen, poor is the quality of testing water. The circuit board regulator is used to supply the current of 1.5Amp.

Experimental Setup for PH Testing: In this project, the pH sensing model directly used to check the quality of water to ensure the water safety and so that the wastage of water also avoided. Here system of pH sensor is designed with microcontroller, which would receive the data signals from sensor for that we have to place the sensor in the surface of the food material to sense the pH level. The status will be sent through zigbee transceiver to the PC section which connected with the zigbee. The display unit gives the status of water sample¹.

Experimental Setup: The hardware setup is designed by using measurement panel, sensing panel, and Control panel and display unit.

A pH measurement circuit is designed by using three basic components, i.e. the sensor element, in which testing electrode, a threshold electrode, and a temperature sensing component are connected; an amplifier circuit which is used to amplify the input signal and an analyzer circuit to convert the signal into its respective pH value. The threshold electrode provides a constant potential against which the testing electrode can be compared.

The humidity sensor is designed by using either glass material or ceramics. The material of the sensor which is generally insulator perform the process of absorption in which it takes in the water and then releases water depending on the relative humidity of the sample material. This phenomenon is used to convert the charge stored in the capacitor of the pH sensing circuit. These modules convert the relative humidity to the output voltage

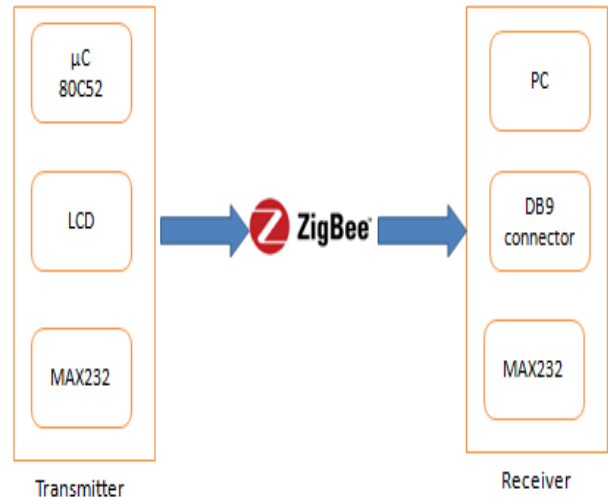


Figure-2
 Block diagram of pH resting model

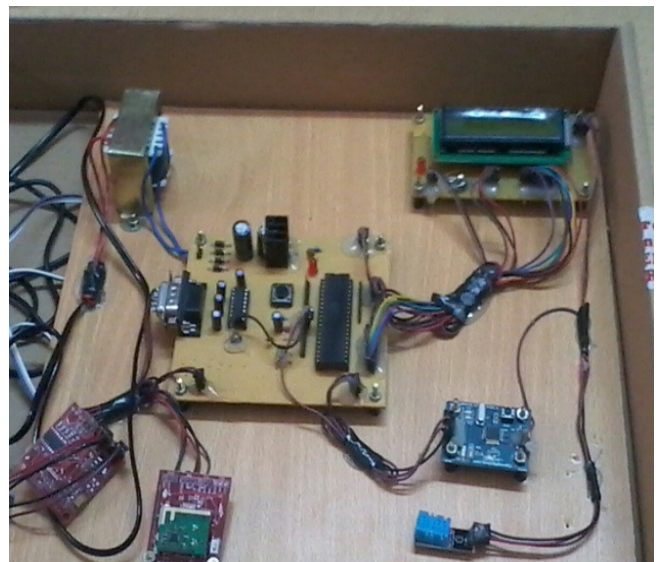


Figure-3
 Experimental Setup of pH resting model

Results and Discussion

Output Response of Hardness Testing Model: Depending on the conductivity of sample water, the corresponding voltage

values converted in proportionate binary values. These values decide the type of water i.e. acidic water, hard water, regular water, distilled water. The voltage response of the water under test is also recorded.

Table-1
Output response of sample water

Sr. No.	Water Sample	Binary Reading on Display(0-1023)
1	Acidic Water	167
2	Hard Water containing Salt	445
3	Regular Water	955
4	Distilled Water	1003

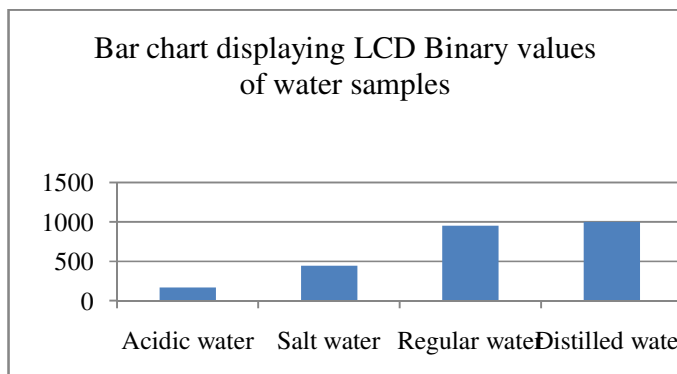


Figure-4
Graphical representation of output response

By analyzing the various sample of water, the water is tested to maintain the quality. The testing sample having higher the value on display record, the better is the quality of water and lowers the quality on screen; poor is the quality of testing water.

Table-2
Output response of sample hard water

Sr .No.	Water Sample	Output Response in Volts at Room Temperature	Temperature	Output Response in Volts at Temperature
1	Distilled Water+ Half Gram Salt	5.050 V	30	4.95 V
2	Distilled Water+ One Gram Salt	2.295 V	40	3.31 V
3	Distilled Water+ Two Gram Salt	2.235 V	50	3.445 V
4	Distilled Water+ Three Gram Salt	1.955 V	75	3.120 V
5	Distilled Water+ Four Gram Salt	1.84 V	100	2.865 V

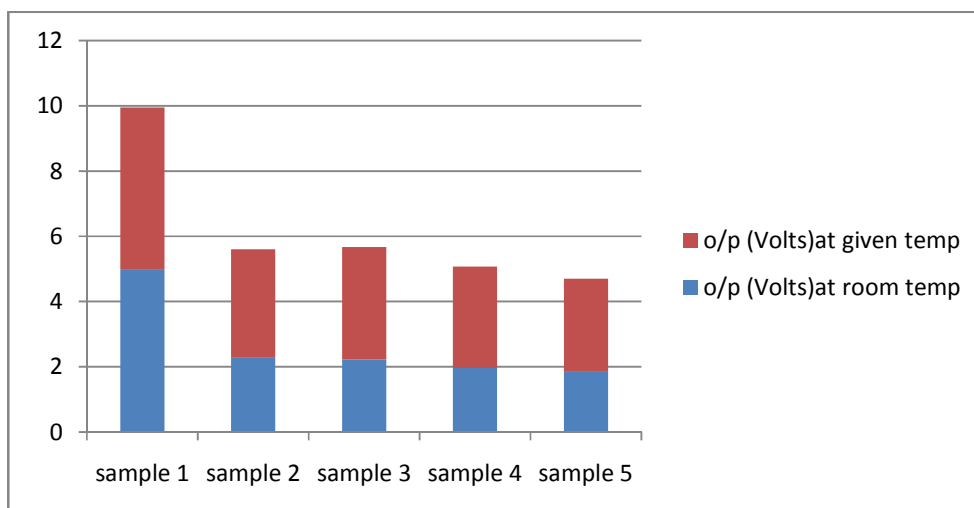


Figure-5
Graphical representation of output response with respect to temperature

The hard water is tested at different level of temperature and the conductivity of water is monitored. The increase in temperature of water sample increases the output voltage response. At boiling point , the conductivity increases, but not reaches to the threshold value at which the water is not a hard water.

interval of time of a day. The variation in the performance parameters like temperature and humidity is recorded.

Output Response of pH Testing Model: The water sample is checked under the different atmospheric condition. The impurity is added in the testing material is analyze at the different

The hard water is tested at different level of temperature and the pH value of water is monitored. The increase in temperature of water sample increases the pH value response. At boiling point, the conductivity increases, the pH value also increases, but not reaches to the threshold value at which the water is not a hard water.

Table-3
Output response of sample hard water

Sr. No.	Water Sample (50 ml)	pH Value at Room Temperature	pH Value at Temperature (100 ⁰ C)
1	Distilled Water + Half Gram Salt	5.8	5.7
2	Distilled Water + One Gram Salt	6.3	6.1
3	Distilled Water + Two Gram Salt	6.7	6.4
4	Distilled Water + Three Gram Salt	7.1	7
5	Distilled Water + Four Gram Salt	7.2	7

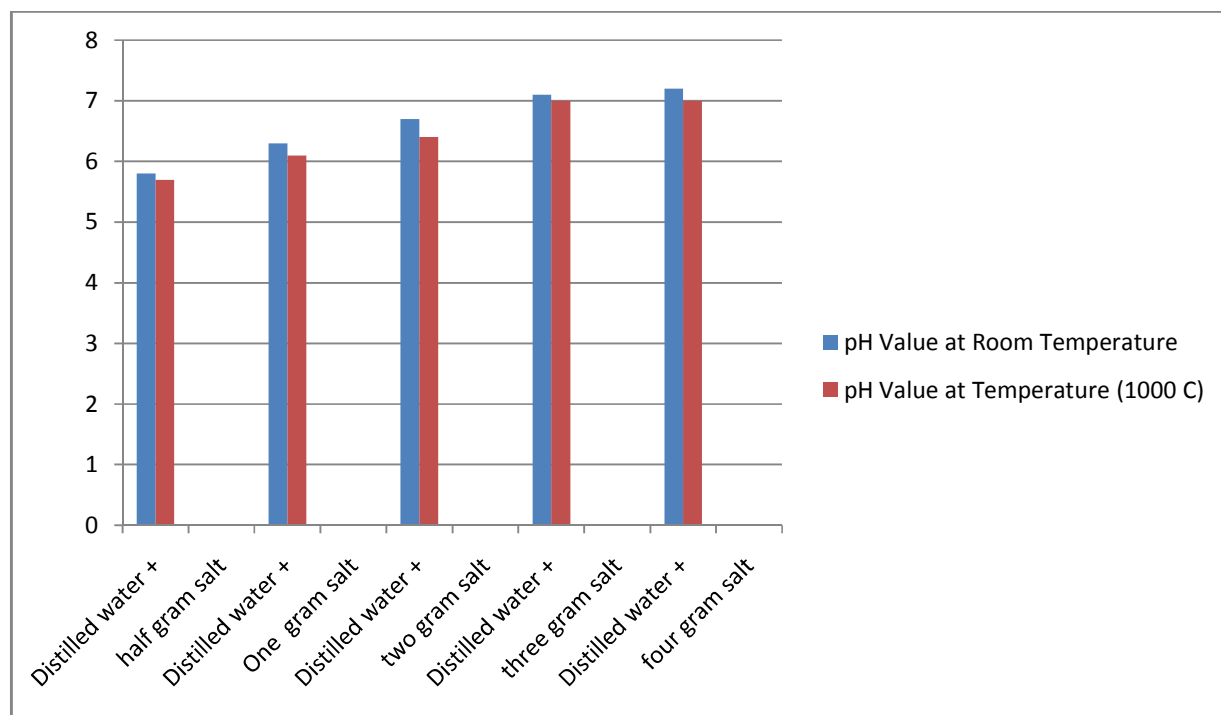


Figure-6
 Graphical representation of output response with respect to temperature

Conclusion

This research work is used to design the system to study the performance parameter of water to check the quality of water. The designed system is used to test the water for various dose responses for more type of infection in a sample, at the various temperatures. This water quality sensor model is very beneficial for the society in various application of water.

This research work is used to design the system to study the water sample. The sample food material is checked under the different atmospheric condition. The impurity is added in the testing material is analyze at the different interval of time of a day by the monitoring pH value and by measuring the hardness of water.

Application: Chemical leakage detection in rivers: This is very important as due to chemical spills in rivers, the aquatic animals and creatures living in the rivers get affected and die in large numbers. So early detection of the leakage will not only save cost of cleaning the river beds, but also save a lot of aquatic life.

Maintain the swimming pool water quality: By testing the pH level and Chloride levels of pool water, the quality of water in swimming pools is maintained.

Maintenance of Fish Tank water: The bacteria, algae, pathogen detection in water are possible to maintain the quality of tank water.

Justification of Research: Water quality management is a main issue of global health goal project and the infection in water take a major crisis on human health. So the system is required to test the quality of water. This electronics model is used to analyze the quality of water on the basis of performance parameters.

Future Scope: As the water safety is prime requirement of society, portable and cheaper system is required to test the quality of water.

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