Testing of Drinking water using Automation

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ABSTRACT

Impure water is the root cause for many diseases especially in developing countries. Millions of people become sick each year from drinking contaminated water. A portable, low-cost and low maintenance automation solution for testing water quality is proposed. The automation device will test drinking water using two sensing measurement, electrolyser and pH and based on output of these sensors hardness or softness of water is checked. The pH sensor measures hydrogen ion concentration and electrolyser measures contaminants present in water. The idea presented can be implemented on hardware for providing safe drinking water.

INTRODUCTION

Every 8 seconds, a child dies from water related disease around the globe. 50% of people in developing countries suffer from one or more water-related diseases. 80% of diseases in the developing countries are caused by contaminated water. Providing safe drinking water to the people has been a major challenge for Governments in developing countries. Conventional technologies used to examine water by testing it into the several labs follows international standards. Our aim is to provide automation solutions to the water testing procedures. This model provides low-cost, low maintenance and effective monitoring system for providing safe drinking water is paramount, especially for the developing countries.

MATERIALS

The process is done by using aurdino automation for which the components required are Aurdino Uno board, Node MCU, Colour sensor, ph sensor, water tubes, electrolyser, beaker, pipe 4 mm and power supply. The basic functions of the components are given below:

1. **pH sensor:** The sensor is used to know or examine the pH value of sample and predict the solution as acidic, basic or neutral. The range of the sensor are 0 to 14, where 0 to 7 are acidic and 7 to 14 is basic. The output of the ph electrode is in terms of mile volt so we need signal conditioning for amplifying signal. Ph value conditioning model is basically preamplifier model which is used for amplifying the signal according to the ph value of sample it will generate 5V which is given to the microcontroller for converting them into ph value. It is used to convert The detection concentration range ofpH0-14.The detection range of temperature is from 0-80 centigrade.

2. **Colour sensor TCS 230:**This sensor is used to detect the colour of the sample. It has capability of sensing 230 colours. Here the purpose of this sensor to detect the colour after electrolysis process and according it will give message that how much contains present into the water.

3. **Aurdino Uno:** It is microcontroller device for controlling any process by providing programing to the controller. It is simplest and easy to handle the cost of device is very low so it is essential for this project.

4. **Node MCU:** The model is use to transfer the data wirelessly to the any android and computer device and controlling is also done through our android devices. It is a low-cost open source IOT platform.

METHOD

There are mainly two methods are used in this model, Electrolysis method and Ph sensing method. The following section explains both the methods.

1. Electrolysis method

This method is used to find out any contaminants present into the water. It consists two electrodes which is treated into the solution to form the ions compound. The process is worked on the principal of electrolysis which is an electrochemical process by which current passes from one electrode to another in an ionized solution that is an electrolyte. In this process, positive ions or cations come to the negative electrode or cathode and negative ions or anions come to the positive electrode or anode. That is oxidation and reduction reaction takes place

Overall reaction of pure water is $2\ H_2O\ (l) \rightarrow 2\ H_2\ (g) + O_2\ (g)$.

Fig: 1: Colour change due to electrolysis of water sample

In the above fig1 there are two sample of water are tested in which colour of both water sample are change due to electrolysis process. In which two colours are form one is dark green and yellow that means as per water testing kit colour provide information of total salt contaminants present in to the water. The electrolysis results according to that amount of contaminants present into the water is shown in the table no 1 From the table, it can be said that when water contains contaminants, the colour of water are formed By knowing the colour, we can tell contaminant concentration present into the water and be able to know whether is it good for health or not.

Table No.1: Different colour for different contaminants present in water sample

Electrolysis Results	
colour	Electrolysis Home
Red & Yellow	Iron Rust
Black	Heavy Metal
Greenish black	Copper, Rust, Lead, Mercury
Blue	Orange Phosphorus Compound
Yellow	Separated Mineral Grains

2. pH sensing method

pH sensor are used to find out pH value of the liquid. This value is varies between 0 to14which means that if the pH value is less than 7 then it is acidic in nature or if it is more than 7 then it is basic in nature and if it is 7 then sample is neutral. The overall working principle of pH sensor and pH meter depends upon the exchange of H plus ions from sample solution to the inner solution (pH 7 buffer) of glass electrode through the glass membrane. The construction of pH sensor is shown in figure2.The sensor consist two electrode one measuring electrode and another reference electrode. The measuring electrode is a tube made up of glass and consists of a thin glass bulb welded to it, filled up with Potassium Chloride solution of known pH of 7. It also contains a block of silver chloride attached to a silver element. It generates the voltage used to measure pH of the unknown solution. The reference electrode is a glass tube consisting of a potassium chloride solution in intimate contact with a mercury chloride block at the end of the potassium chloride. It is used to provide a stable zero-voltage connection to complete the whole circuit. When the electrode is deep in to the sample the H^+ ions are generated which get attract towards thin glass members and reaction with KCl solution takes place whose output is come interms of millivolt . This signal get amplified by using amplifier and according to that pH value is generated.

The purpose of this sensor in this model to find out hardness of the water. Hard water contains more contaminants present resulting in high pH value. The pH value more than 8.5 is not good for human body. This model gives an idea though this pH sensor whether the water is good or not and find out total hardness of the water.

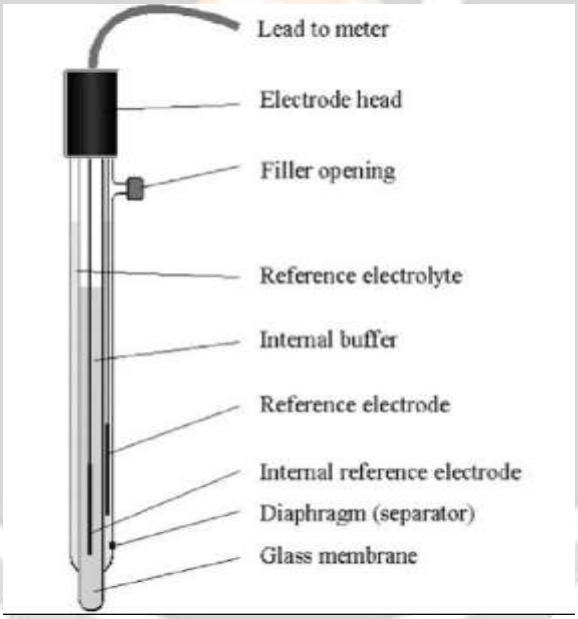

Fig. 2: Construction of pH sensor

Proposed System

The system consist of water samples from beaker which may passed through both electrolyser chamber and pH sensor attached beaker simultaneously. The pH sensor output get amplified through signal conditioning device and acquired using microcontroller. At same time, water samples are passed through electrolyser chamber and colour sensor. The colour sensor provide output signal to the controller. This all data then passed through Node MCU and it will transfer this information to the computer and shows on display.

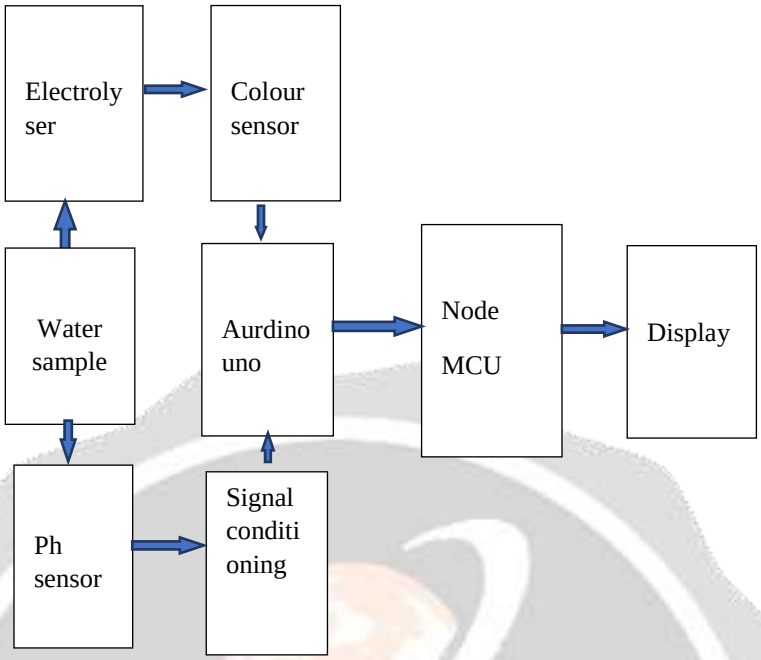

Fig. 3: Block diagram of proposed system

The block diagram of proposed system is shown in fig:3 Here we test and calibrated water with pure water following with Indian water standard. Water sample is taken into the beaker by using 4mm pipe from the source. Water H^+ concentration is sensed by pH sensor to indicate hardness of the water sample .At same time it will passed through the electrolyser chamber where electrolysis of water is done the results of electrolysis process gives a basic information of water contaminants present into the sample. Colour sensor is used to detect the colour of water after the process of electrolysis and this data is passed to the microcontroller and then this data is transferred to the node MCU for providing sample information to the computer .The complete process is controlled by using aurdino uno.

Discussion

In this model, water samples are tested in two methods which make them more accurate and effective. One is using Ph sensor and another is electrolyte device, due to this both the model are calibrated with each other. The both device are working together in this process, and gives output simultaneously to the microcontroller their after this data can be transferred to the computer using Node MCU board. This model could provide output which would be good in accuracy and time reducing so that it is very helpful for testing water sample to get quick response.

CONCLUSION

In this work, a system to test water quality is proposed. The functioning of block diagram is presented and can be implemented on hardware for a low cost, easy to use water quality testing automation unit. The system uses two methods, pH sensing method and electrolyser method, which could make the system more accurate and effective. In the future, the system would be implemented on hardware for real time water quality testing.

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