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Estimation of Water Quality using Wireless Sensor Networks

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Abstract: Water pollution is one of the biggest fears for the green globalization. In order to ensure the safe supply of the drinking water the quality needs to be monitor in real time. This project discussed about the design and development of a low cost system for real time monitoring of the water quality in Wireless Sensor Network. The system consist of several sensors is used to measuring physical and chemical parameters of the water. The parameters such as TDS, pH, turbidity of the water can be measured. The measured values from the sensors can be processed by the core controller. The PIC 18F4520 can be used as a core controller. Finally, the sensor data can be viewed on Android Application using Wi-Fi (Wireless Fidelity) system. Based on the parameters, the quality of the water can be estimated and classified for future applications.

I. INTRODUCTION

In the 21st century, there were lots of inventions, but at the same time were pollutions, global warming and so on are being formed, because of this there is no safe drinking water for the world's pollution. Nowadays, water quality monitoring in real time faces challenges because of global warming limited water resources, growing population etc. Hence there is need of developing better methodologies to monitor the water quality parameters in real time. The water quality parameters pH measures the concentration of hydrogen ions. It shows the water is acidic or alkaline. The water quality monitoring is the essential need for the human life. There are huge numbers of diseases which cause through the polluted drinking water. The water will be polluted by the human being, animals, natural disasters and seasonal changes.

People have to aware of their own locality water bodies conditions. To enable this a prototype is proposed to monitor the quality of water using Wireless Sensor Networks. The water quality parameter pH show water is acidic or basic. Pure water has 7 pH value, less than 7 values indicate acidity and more than 7 indicate alkalinity.

The normal range of pH is 6 to 8.5. In drinking water if the normal range of pH doesn't maintain it causes the irritation to the eyes, skin and mucous membranes. Also, it causes the skin disorder. The conductivity indicates the ability of water to pass an electrical current. Water is affected by various dissolved solids such as chloride, nitrate, sulfate, sodium, calcium, etc. Turbidity has indicated the degree at which the water loses its transparency. It is considered as a good measure of the quality of water. Higher the turbidity higher the risk of diarrhea, collera. Lower the turbidity, then the water is clean. Traditional methods of water quality monitor involve the manual collection of water samples from different locations.

II. LITERATURE SURVEY

A. Statistical Report On Water Quality

The WHO (World Health Organization) estimated, in India among 77 million people is suffering due to not having safe water. WHO also estimates that 21% of diseases are related to unsafe water in India. Also, more than 1600 deaths alone cause due to diarrhea in India. Therefore various water quality parameters such as total dissolved salts, conductivity, pH and turbidity should be monitored in real time as shown in Table.1 report on water quality.

Parameters monitored	Quality range	Units
Turbidity	5–10	NTU
pH	6.5–8.5	pH
Conductivity	300–800	micro S/cm

Table.1 report on water quality.

According to the WHO the pH for drinking water is 6.5-8.5 pH. Then the turbidity and conductivity for the drinking water is 5-10 NTU and 300-800 micro S/cm respectively. Beyond this range the water is not suitable for drinking purpose.

B. Survey On Exisiting Method

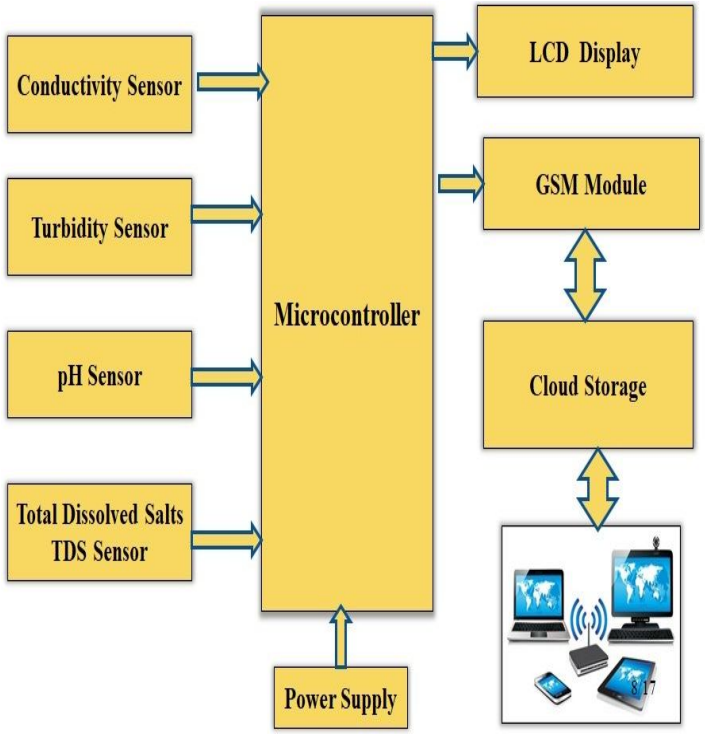
Khurana, Singh, Prakash anrd Chhabra (2016) described the design of IoT (Internet of Things) based water quality monitoring system that monitor the quality of water in real time. Their system consists sensors which measure the water quality parameter such as pH, turbidity, conductivity, dissolved oxygen, temperature. The measured values from the sensors are processed by microcontroller and these processed values are transmitted remotely to the core controller that is Raspberry pi using Zigbee protocol. Finally, sensors data can view on internet browser application using cloud computing. Vijaya Kumar and Ramya Kedia (2015) explored on water quality monitoring methods, sensors, embedded design, and information dissipation procedure, role of government, network operator and villagers in ensuring proper information dissipation. They also explored the Sensor Cloud domain. While automatically improving the water quality is not feasible at this point, efficient use of technology and economic practices can help improve water quality and awareness among people.

III. METHODOLOGY

A. Block Diagram Of Estimation Of Water Quality Using Wireless Sensor Network

In the proposed block diagram, several sensors (Conductivity, Turbidity, pH, Total Dissolved Salts) are connected to microcontroller. The microcontroller is accessing the sensor values and it is processing them to transfer the data through internet.

Fig.1 Block diagram of estimation of water quality using wireless sensor network

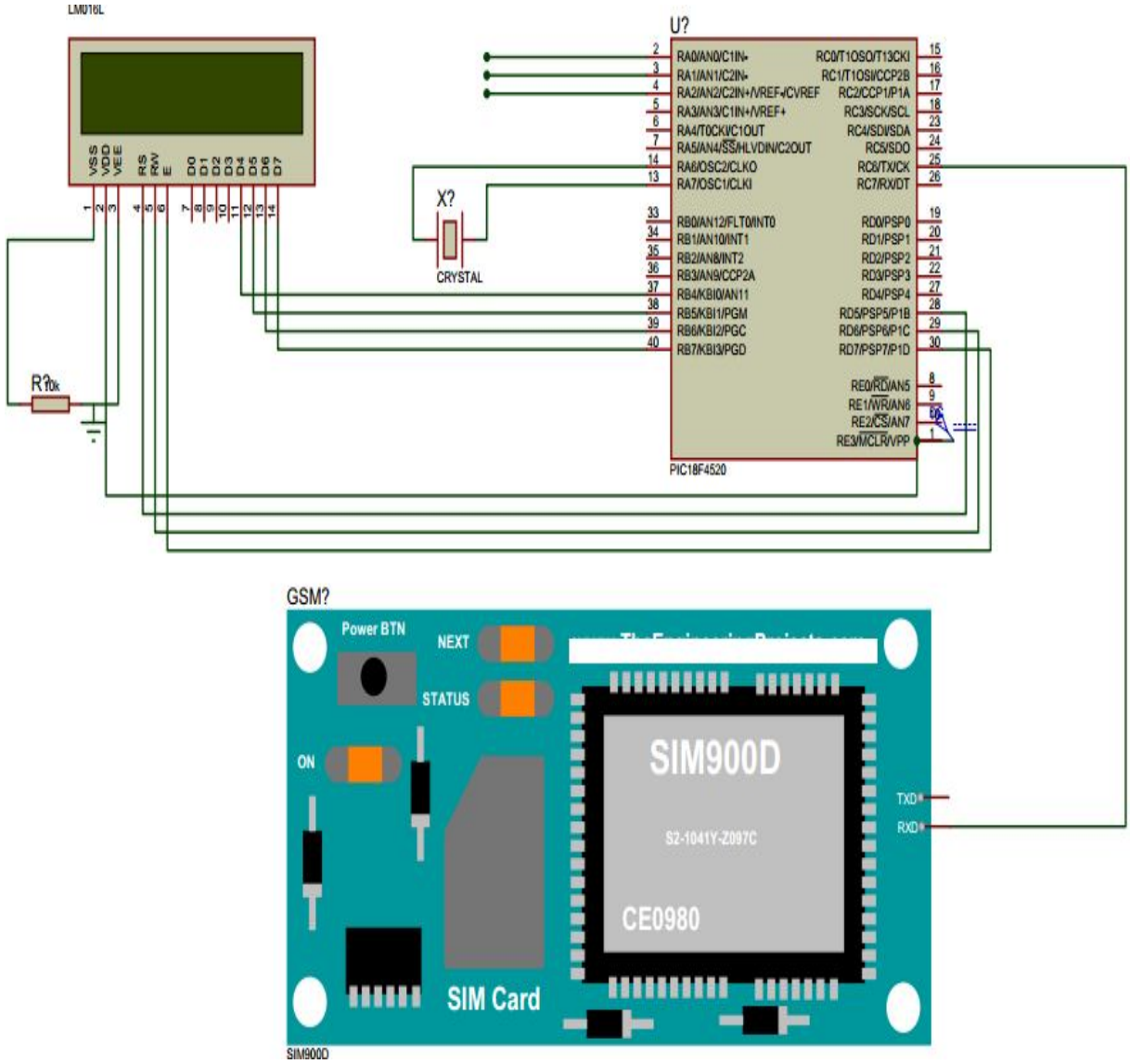


PIC 18F4520 is used as a core controller. The result can be viewed on the android application.

B. Circuit Diagram Of Estimation Of Water Quality Using Wireless Sensor Network

The circuit diagram of Estimation of Water Quality using Wireless Sensor Network as shown in Figure 2. A physical sensor is connected to the RA0,RA1 and RA2 pins of the microcontroller. The analog input signal is converted into digital signal with the help of built in 10-bit ADC (Analog to Digital Converter in PIC 18F4520. The output of the ADC is sent to the LCD display through D4, D5, D6 and D7 pins. PIC microcontroller transmitter pin RC6 is configured to the receiver pin of the SIM 900 GSM.

Fig.2 Circuit diagram of estimation of water quality using wireless sensor network



Using appropriate AT (AT tention) commands GSM is transferred data to respective IP address. Hence the quality of the water parameter is viewed anywhere in the world.

C. Algorithm for Estimation of Water Quality using Wireless Sensor Network

1) Start the process
2) Sensor units senses the quality of water parameters and send the corresponding signals to microcontroller.
3) Microcontroller displays the local values of sensor units using LCD display
4) Three conditions occurs
5) pH<7,sample water is Acidic
6) pH=7,sample water is Neutra
7) pH>7,sample water is Alkaline
8) The collected data stored in cloud space using GSM Network
9) The data can be retained by Android Application from the specified cloud space.
*10)*Status of the quality of water is viewed with the help of Android Application.
*11)*Stop the process.

D. Design and Calculations of Water Quality using Wireless Sensor Network

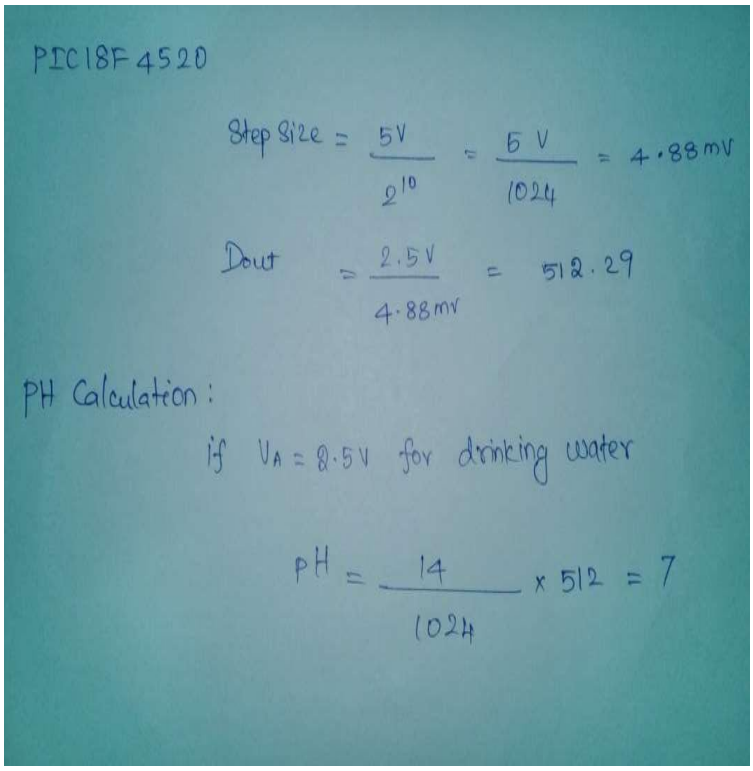


Fig.3 Design and Calculations of Water Quality using Wireless Sensor Network

The Figure.3 describes design calculations of Estimation of Water Quality using Wireless Sensor Network. The PIC18F4520 has built-in 10 bit ADC. The resolution of the ADC is calculated using the formula R = 2n (where n = number of bits). With the resolution of ADC and reference voltage (Vref = 5 V), the step size is calculated using the formula (1). Then the Dout (Digital output data) is calculated using formula (2) where Vin = 2.5 V (output from pH meter) and step size = 4.88. The Digital output multiplied with ratio of maximum range of pH to the resolution of ADC results in pH value

IV. HARDWARE DESCRIPTION

A. ph Sensor

The pH of a solution is the measure of the acidity or alkalinity of that solution. The pH scale is a logarithmic scale whose range is from 0-14 with a neutral point being 7. Values above 7 indicate a basic or alkaline solution and values below 7 would indicate an acidic solution. It operates on 5V power supply and it is easy to interface with PIC. The normal range of pH is 6 to 8.5.The photograph of pH sensor is shown in the Figure .4

Fig.4 pH sensor

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B. Conductivity Sensor

Conductivity is the measure of solutions ability to carry current as shown in Figure 4.4 .This parameter is used to determine the salt content in the water. In the proposed design, YL-69 is used to measure the conductivity of the water. It consists of two electrodes, when placed in water a potential is generated which is proportional to conductivity. It is measured in seimens per cm. Acceptable range of conductivity is from 300 to 800 µ seimens per cm.

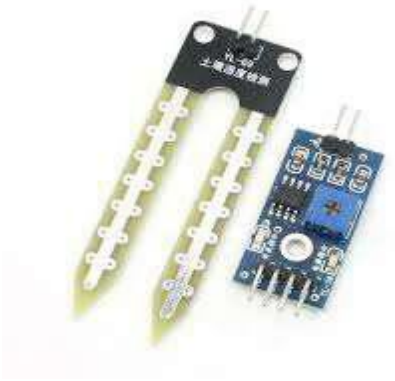

Fig.5 Conductivity sensor

C. Turbiditty Sensor

Turbidity is a measure of the cloudiness of water. Turbidity has indicated the degree at which the water loses its transparency. It is considered as a good measure of the quality of water. Turbidity blocks out the light needed by submerged aquatic vegetation. It also can raise surface water temperatures above normal because suspended particles near the surface facilitate the absorption of heat from sunlight.

Fig.6 Turbidity sensor

V. RESULT

pH sensor gives the voltage range 1-5V with respect to 1-14pH. This analog signal is fed into microcontroller unit and it displays the status of water such as acidic, neutral or alkaline. The microcontroller sends a data packets to cloud space. An Android Application draws a data from cloud space using GPRS (General Packet Radio Service) Network. This project is tested with three different solutions like Hydrochloric Acid, Drinking Water and Sodium Hydroxide. A pH meter is employed to sense the pH range of the solution. The output of pH meter is in Volts. If pH is less than 7, the solution is acidic. If pH is equal to 7, the solution is neutral. If pH is greater than 7, the solution is alkaline.

VI. CONCLUSION

The purpose of this project is to develop water quality monitoring system using Wireless Sensor Network. The main objective was to reduce the time required for testing of water in laboratories and to achieve it. It reduces the laboratory equipment that would be required for the traditional way of testing the water for its quality. The major point is to record all the details obtained in cloud. The results can be viewed and fetched whenever required. The monitoring of water can be done online easily using this system. This project gives clear ideas on how to monitor water in real time measuring in an urban area to ultimately improve the water quality of urban dwellers.

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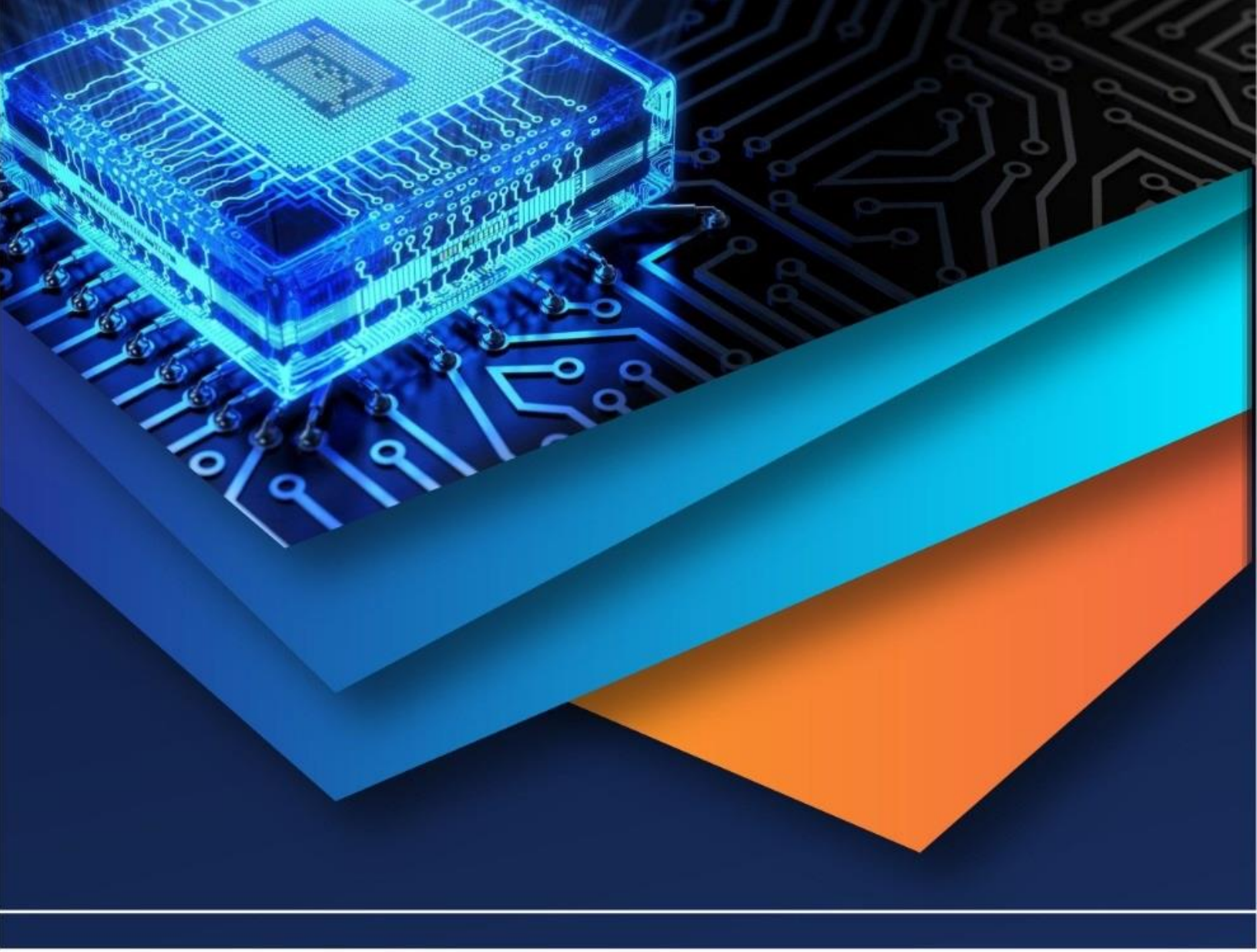

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