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Monitoring Water Contamination Using ORP Sensor

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Abstract: Water is one among the life essentials. It is important to prevent water from being contaminated. Thus we propose a sensor technology to monitor the water quality parameters and detect before the water is being contaminated. In this paper we have used "Network Simulator 2" to simulate the sensors. The pH sensor, conductivity sensor, temperature sensor, ORP sensor and dissolved oxygen sensor are considered as nodes. If the readings from the sensors reach the threshold value (abnormal value) then the information from the particular sensor is sent to the cloud node. From the cloud node the information is then dispatched to the particular mail id's and phone numbers.
Index terms: Water quality parameters, pH, Conductivity, Temperature, ORP, Dissolved Oxygen, Cloud

I. INTRODUCTION

Our earth contains 71 percent of Water bodies. Out of which only 2.5 percent of water is considered to be fresh water that can be used for drinking purpose in lakes, rivers and ponds. This tells that's water plays a leading role in all aspects of day today life. We use water for drinking and household purposes like cleaning, washing clothes and utensils. Safe and Clean water is vital for drinking purpose for human and other life forms even though it does not provide any organic nutrients or calories, yet it acts as a main source of living. The quality of water is the predominant factor to be noted while making use of it. The water quality parameters are the key points to be noticed to check if the water is contaminated. Nature always has a limit or threshold for its usage, same way the water has its own parameters that mark a threshold value which tells the quality of water for usage.This paper elaborates on monitoring the water quality in water bodies and detecting the contamination that can take place. We implement this using NETWORK SIMULATION 2 by simulating the sensors as different source nodes and multiple clouds has destination nodes for storing the data generated from the sensor nodes. There are few nodes that act as relay nodes to find the optimum route from source to destination node. The network of sensor nodes gives the information regarding the water quality parameters when they reach the threshold limit of contamination. Thereby, these stored information in cloud will be send as Email and text messages to authorities and registered users.

II. RELATED WORK

There are various methods and implementation to check the water quality using sensor technology and many studies are carried on this in literature. In [4] a distributed system for measuring water quality was designed and implemented. The sensors are taken as source and the readings are given to GSM land based station and this work focus on the processing of sensor data using Kohenen maps (auto-associative neural networks). Dissolved Oxygen and conductivity illustrated in [5]. The ZigBee technology and CDMA technology is used as monitoring nodes. In [6] water system monitoring system is implemented in process and analyses of water quality parameters pH, Temperature, Dissolved Oxygen, Conductivity and sends sound alarm when the water gets contaminated. These parameters are measured with off-the shelf sensors and then the data is sent to base station through GPRS (General Packet Radio Service).In addition [7] deals with Turbidity and then low powered, easy to use, low cost and small sized at [8]. Moreover partial and temporal distribution of water quality and environmental parameters of river catchment are spoken in detail in [9].Microcontroller-based WSN system was proposed in [10] measures Chlorine concentration and temperature in water pool. The data is transmitted using GSM from the sensor nodes. In [11] the fresh water quality is measured using solar daylight for optimized power usage, and then the data is collected in sub-nodes then transferred to monitoring station using GSM.In [12] WSN-based on ISO/IEC/IEEE 21451 standard for surface water monitoring is done to capture unusual events and gather data regarding them.In [13] Real time water-quality monitoring is done with help of sensors using voltage parameters and current. ZigBee and GSM technology is used along with measurement node and notification node which sends a buzzer noise when contamination occurs.

III. METHOD

The proposed water quality system design has various water quality parameters (pH, conductivity, Turbidity, ORP, Dissolved

Oxygen, Temperature) to look up and these values generated from the sensors are stored in cloud node (simulation) further sent to official and registered (public) email-id's and SMS (short message service) to mobile.

IV. QUALITY PARAMETERS

The quality of water for drinking purpose is mentioned in many standards like World Health Organization (WHO), Safe Drinking Water Act (SDWA) which generates details on the right water parameter values. pH, Chlorine, Dissolved Oxygen, ORP, Nitrate levels, flow.

A. pH SENSOR

The first water parameter that needs high focus is pH (Potential of Hydrogen) was originated from a French term Pouvoir Hydrogen which is a chemical component scale to find the hydrogen content in water. This scale ranges from 1 to 14 and the accurate value for drinking purpose is 7. Below 7 is considered to be acidic and above 7 considered to be basic. Fresh water can contain 6.5 to 8 scales in pH.

B. Temperature Sensor

This sensor is used to measure the temperature range of water. The temperature of water varies according to the climatic and day/night conditions. The water temperature depends on the environment geographical location and season. The usual temperature of drinking water would be around 7 to 44 degree Celsius. When unusual chemicals are mixed with water it may cause temperature rise which crosses the abnormality. These issues are governed by this sensor.

C. Conductivity Sensor

This deals with electrical conductivity of water, how well the solution conducts electricity. It is an indication that how ions or free moving electrons that are present for conductivity of electricity. This is usually measured in Siemens per meter (S/m) or micro-Siemens per centimeter (mS/cm). This sensor is designed with electrodes and follows Ohms law.

D. Turbidity Sensor

Turbidity is quantitative measure of suspended particles in water it may be soil in water or even chocolate flakes. To find the turbidity of water we make use of turbidity sensor that senses the solid contents that are mixed in drinking water. This turbidity is measured in Nephelometric Turbidity Units (NTU). The agreed level of NTU in drinking water is 0-5.

E. Oxidation Reduction Potential Sensor

ORP is best defined as a measure of cleanliness and ability to breakdown contaminants in drinking water. It ranges from -2000 to +2000 and is measured in milli Volts (mV). The accepted range of ORP is 650 to 800.

F. Dissolved Oxygen Content

This dissolved oxygen content refers to the level of free, non-compound oxygen in water, which acts as an important parameter to check the quality of water. The dissolved oxygen level which is too high or too low may even affect the aquatic life. The amount of dissolved Oxygen varies from species to species and not a permanent parameter. The surface water contains 4-15 mg/L of dissolved oxygen content. It is measured in milligrams per liter.

V. SYSTEMS DESING

The system is split into four sub-systems; the sensing node; the measurement node; the wireless node; and the notification node. The sensing node contains all the water quality sensors, as well as the signal conditioning circuits required to interface with the measurement node. The measurement node consists of a microcontroller that processes the raw sensor data and then transmits the data to the wireless transmitter module. The wireless transmitter and receiver modules are part of the wireless node and are used to relay the data to the notification node. The notification node receives data from the wireless receiver module and then notifies the user through message in real-time of the water quality and also sends data to the public cloud server. After the designing of the subsystem the results are simulated using the NS2, that is the transmission of data from the sensor to cloud is simulated using the network simulator 2.The data collected from the sensor are transmitted to the cloud by the notification node. The notification node sends the data to the cognitive sensing node in the particular mesh topology. The sensor nodes are formed into mesh topology and each of the domains has a cognitive sensing node, which accepts maximum number of information in that domain.

Then the data from this node is sent to forward node of the domain which send the data to the addressed cloud.

VI. SIMULATION

After completing the system design, the overall system can be viewed as measurement node which senses and measures the information from the sensor and the notification node which transmits the information from the sensor to the cloud and to the user through the message.

The simulation results are shown in the figures 1, 2, 3

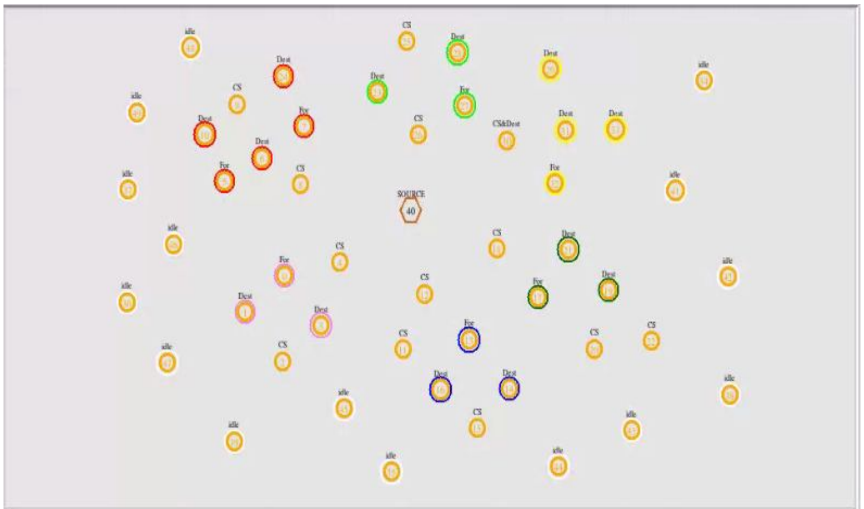
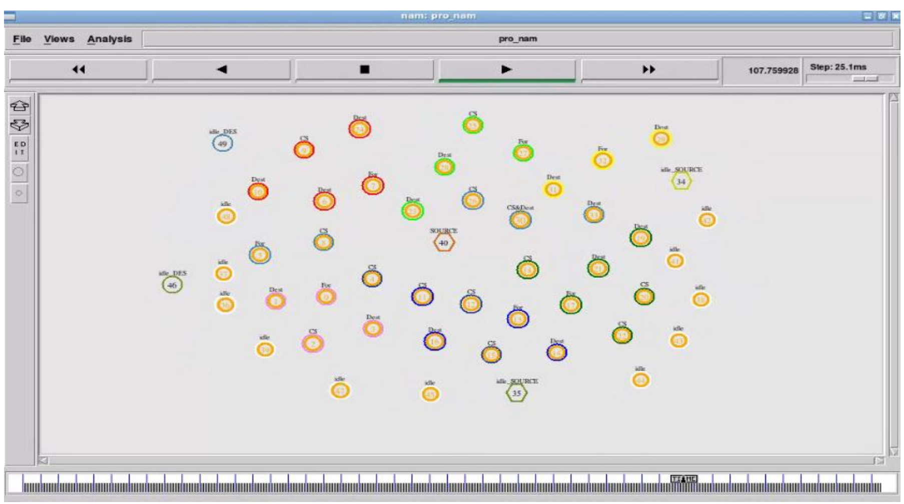


Figure:1



Figures 2

VII. CONCLUSION

A sensor node with a temperature, conductivity, pH, ORP and flow sensors was designed and constructed on a Vero-board, which also included the respective signal conditioning circuits. The temperature sensor was completed using a thermistor based design. The conductivity sensor design was based on a two-electrode method. The signal conditioning circuit yielded acceptable results. The conductivity cell/electrodes were however not verified. The pH sensor made use of a glass electrode and yielded acceptable results. The flow sensor design made use of a turbine flow meter and yielded good results. The ORP sensor signal conditioning as a whole was a success and had acceptable accuracy. The ORP electrode itself was not calibrated. A measurement node consisting of a microcontroller was implemented to process the raw sensor data into usable measurement values. The microcontroller then transmitted the measurements wirelessly to the notification node via the wireless XBee modules. A wireless node was implemented using two XBee modules configured for peer-to-peer communication. A notification node sends the data to the registered mobile users and to the public cloud server when the sensed value is abnormal. The accuracies of the different sensors and other findings are as follows. Temperature sensor: 2.5◦C. Conductivity sensor: 14.71% (unverified). Flow sensor: 6.28%. pH sensor: ±0.51. ORP sensor: ±24.14 mV. Future work involves the actual transmission of the data from the sensor to the cloud directly using the sensor to cloud technology.

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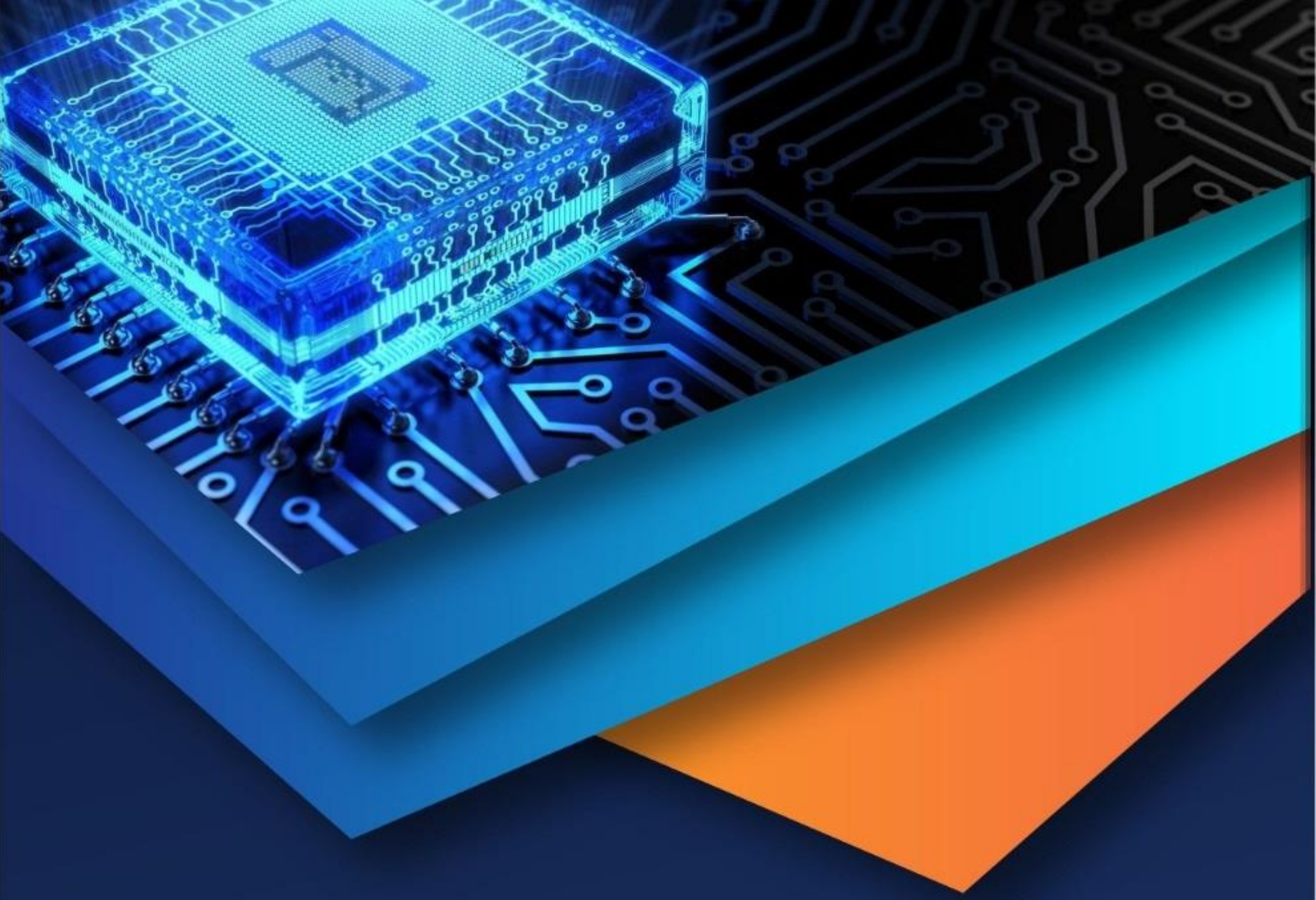

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