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A Modern Real Time Water Quality Monitoring System Using IOT

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ABSTRACT: *Now-a-day, water pollution is one of the biggest fears for the green globalization. Water is used in various activities, such as consumption, agriculture and industry, which may affect water quality. Therefore, the water quality monitoring is necessary which includes several chemical parameters. Some of these are: pH, redox potential, conductivity, dissolved oxygen, ammonium and chloride ion amount. There is a need to improve existing system for monitoring water bodies, given that laboratory methods are too slow to develop an operational response and does not provide a level of public health protection in real time. Due to the vast increase in global industrial output, rural to urban drift and the over-utilization of land and sea resources, the quality of water available to people has deteriorated greatly. To increase the water quality, first we have to estimate the water parameters like pH, turbidity and temperature as the variations in the values of these parameters point towards the presence of pollutants. The water quality measuring system that we implement checks the quality of water in real time through various sensors (one for each parameter: pH, conductivity, temperature, turbidity). The Wi-Fi module in the system transfers the data collected by the sensors to the microcontroller and transfers the data to the smart phone/PC. This system can keep a strict check on the pollution of the water resources and be able to provide an environment for safe drinking water.*

Keywords — Redox potential, Turbidity, Microcontroller, Deteriorated, Pollutants.

I. INTRODUCTION

Globalization has been adversely effecting the environment through the challenges such as deforestation, climate change, pollution, bio-diversity loss and water resources. Globalization is theoretically refers to a complex process that includes political, economic and sociocultural changes. The rapid changes implemented in the manufacturing and the agricultural trends are immensely influencing water use as well as wastewater production patterns and the potential implications of these trends on the water quality. Various pollutants generated as byproducts in the production of plastics, synthetics, pesticides, detergents, pulp and paper, and other materials has posed a threat to water-quality and is conceivably a human health hazard if not regulated and managed properly. The continued growth of large-scale, corporate agriculture has implied to an extensive use of pesticides and fertilizers. The production levels of toxic wastes also are a concern to environmental quality, particularly as trade in toxic wastes increases. Hence the use of a system to independently measure the constituents of the water is essential.

II. MOTIVATION

Water is an indispensable source for the existence and survival of the life on earth. With the huge advancements of civilizations, water has found in the large and progressive increasing list of uses. Many nations which have a fair estimate of their oil and mineral resources, hardly know their water resource potential. In a country like India, where the rainfall pattern is highly variable and most of the people depend upon agriculture and allied activities, the appraisal and planning of water resources has became an important component for its development. The problem related to the water surfaced in the year 1990s. People started to privatize the water sources and the Urbanization brought the natural cycle of water to a halt. The recent surveys conducted on the water bodies have phenomenally surprised the people as most of the samples concluded to be inappropriate for any use. Indian Institute of Science (IISc) conducted a research in 2014 on water bodies in Bangalore and found that severe pollution of water bodies as well as groundwater lead to many serious health hazards.

Karnataka's Mines and Geology Department published a report that said, Nitrate content was in excess of the permissible limit in 29% of the samples, iron in 10%, total hardness in 8.5% and fluoride in 0.6% out of 2209 samples of water covering entire city.

The survey in the year 2018 showed that the India's groundwater is flooded with fluoride. Fluoride is an acute toxin with a rating slightly higher than lead. In fact it is one of the most bone-seeking elements known to human beings and the groundwater in India shows the presence of unhealthy quantities of fluoride. Karnataka has been ranked as the 4th state for having the high presence of fluoride in the water bodies.

III. PROPOSED APPROACH

Clean consumable water is a critical resource that is important for the health and well-being of all humans. Water is a fuel for all life and no lives can survive without water on this planet.

Hazardous and unpredictable, various categories of chemicals are collapsed with the drinking water which arrives through industrialization, globalization, urbanization, agriculture etc. It is a need to check the water regularly using agile technologies. From our project we assure that water quality measuring is done automatically.

The deterioration of water resources becomes a common human problem. The proposed system employs the use of multiple sensors to measure the difficult parameters in water there by measuring the quality of water in real-time for effective action.

The proposed system consists of ThingSpeak as the interface module. ThingSpeak is an open-source Internet of Things application and API key, an unique identity feature to store and retrieve data from things using the HTTP protocol over the Internet or via a Local Area Network.

The objective of the system is to design a low cost and robust system, to monitor water quality problem for drinking water and online multisensory measurements at the local level are developed to assess the water contamination risk. The overall functions of the system architecture are:

• A microcontroller is been used for collecting the data from the sensors in the Arduino NANO.

• The system contains turbidity sensor, pH sensor, a temperature sensor which is interfaced with Arduino NANO

- Turbidity sensor is used for turbulence measurement of water.
- The PH sensor is used to measure the %PH of water.
- The temperature sensor is used to check the temperature of water.
- The Conductivity sensor is used to measure the ability of the water to carry electric current.

- All these sensors are directly connected to the microcontroller.
- The microcontroller collects the data and processes it with Wi-Fi module.
- The Wi-Fi module (ESP8266) in the NodeMCU transfers data to the PC where the data analysis is done.
- LCD display has also displayed the output correspondingly.
- To publish the corresponding record over the web for private information and further assessment of water resource we are using the python coding.
- To analyze the sample of data and show the status using the csv file through python coding.

ThingSpeak: It is a open-source Internet of Things (IoT) application and API to store and retrieve data from things using the HTTP protocol over the Internet. The time- to-time monitoring of the sensors data are collected and displayed in form of graphs.

The values of the sensors are updated dynamically through the NodeMCU to the ThingSpeak cloud. The ThingSpeak applies MATLAB algorithm that intelligently segregates the data with precision for the further application. ThingSpeak has the in-built libraries for the data segregation and data analysis. The data after segregation and analysis is available in the xml, csv and json format, through which we can further apply the data.

Arduino: Arduino is an open source hardware and software used for building digital devices and interactive objects that can sense and control objects in the physical and digital world.

Arduino consists of both a physical programmable circuit board and a piece of software or IDE (Integrated Development Environment) that runs on your computer, used to write and upload computer code to the physical board.

NodeMCU: NodeMCU is an open source IOT platform with a Wi-Fi soc (system on a chip). It combines the features of Wi-Fi access point and station microcontroller.

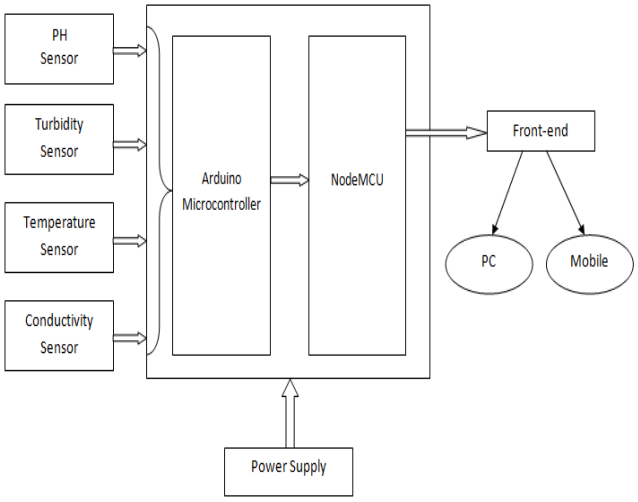

Fig. System Diagram

Ph Sensor: A ph Meter is a scientific instrument that measures the hydrogen-ion concentration in water-based solutions, indicating its acidity or alkalinity expressed as ph.

The difference in electrical potential relates to ph of the solution. PH is a logarithmic scale that ranges from 0-14, with neutral point being 7. Ph value for pure water is 7.

Fig. PH Sensor

Turbidity Sensor: Turbidity is the quantitative measure of suspended particles in a fluid such as soil particles in soil. Turbidity Sensor along with a micro controller unit takes care of turbidity measurements.

Crafted with plastic and some metal-alloy traces, turbidity sensor uses light to convey.

Fig. Turbidity Sensor

Temperature Sensor: An analog temperature sensor is a chip that tells the ambient temperature of the water (hot or cold).

This sensor uses a solid-state technique to determine the temperature, the use of actual fact as temperature will increase; the voltage across a diode will increase at an acknowledged rate. Technically, this is actually the voltage drop between the base and emitter.

By exactly amplifying the voltage change, it is simple to generate an analog signal that is directly proportional to temperature.

Fig. Temperature Sensor

Conductivity Sensor: Conductivity sensors measure the electrical conductivity ability of a solution (here given sample).

Conductivity is a key parameter for unmoved measurements of many basic fundamental physical properties of water.

For water, the power to conduct electrical current is mostly dependent on temperature and therefore the amount of inorganic dissolved solids.

Salinity is defined as the concentration of dissolved solids. This means that, together with temperature and depth information, a good estimate of the salinity may be determined.

By using the inductive principle, stable measurement can be obtained without utilizing electrodes that are easily fouled and may wear out in the sector.

It is affected by the presence of dissolved solids such as chloride, nitrate and phosphate.

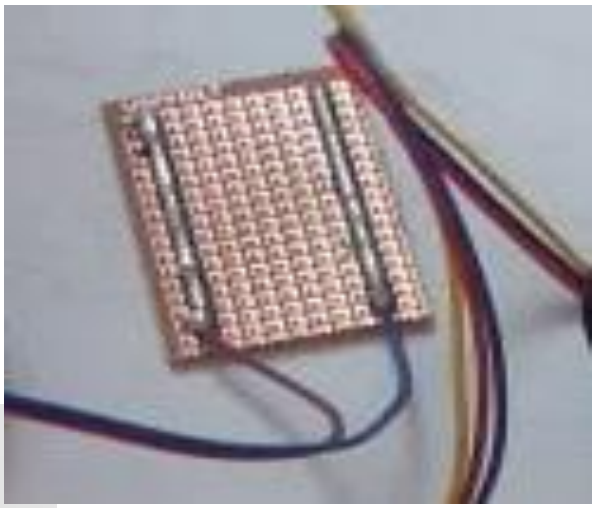

Fig. Conductivity Sensor

IV. RESULTS AND DISCUSSIONS

The resulting values for the different sensors (temperature, ph, conductivity and turbidity) depend on the water samples that it is immersed in. The result is displayed on the PC through ThingSpeak. It consists of a Arduino NANO microcontroller along with the NodeMCU for the Wifi applications. All the sensors are connected to the Arduino NANO microcontroller which consists of an IC. The controller unit is connected to the PC.

We have identified and used a suitable implementation model that consists of different sensor devices and other modules, their functionalities are shown in figure.

In this implementation model we have used NodeMCU with Wi-Fi module. Inbuilt ADC and WiFi module connects the embedded device to internet. Sensors are connected to Arduino NANO board for monitoring, ADC will convert the corresponding sensor reading to its digital value and from that value the corresponding environmental parameter will be evaluated. After sensing the data from different sensor devices, which are placed in particular area of interest. The sensed data will be automatically sent to the web server (ThingSpeak), when a proper connection is established with sever device.

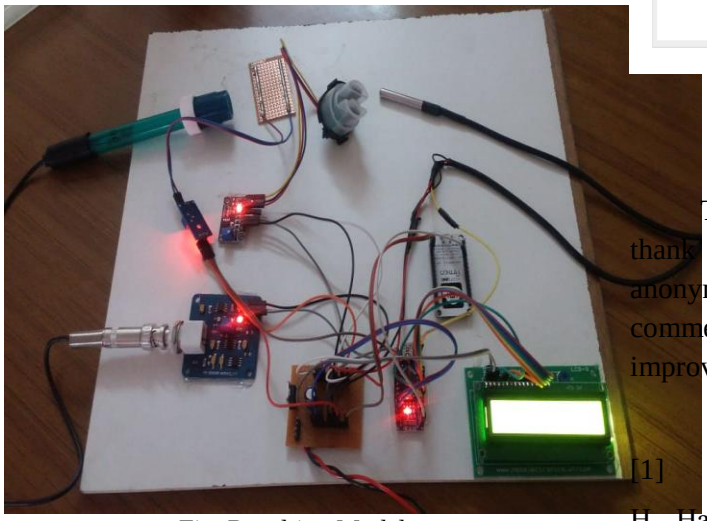

Fig. Resulting Model

The resulting graph for the values of the sensors is as following. The values are updated on the real time basis and the graph changes accordingly.

Fig. Graph of pH, Conductivity, Temperature and Turbidity

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