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Solar Powered Smart Water Quality Monitoring System using IoT

Abhijit D Ghorpade[1], Arpit Ghosh[2], Athmi J[3], Vyshak S M[4], Raji C[5]
[1.2.3.4,5] *School of Electronics and Communication, REVA University, India.*

ABSTRACT

Water quality monitoring is one of the most pressing needs even today. The lab tests for monitoring water quality are complex and consume time. With the rapid development of technology, advancement in Internet of Things (IoT) and free solar energy, our proposed system provides a solution to the water quality monitoring problem. This paper presents a solar powered, standalone system for monitoring the water goodness by employing 6 different sensors- Water level, ph level, Temperature, Conductivity, Carbon Dioxide (CO2) level & Turbidity. The system consists of a solar panel, microcontroller board, sensors, Wi-Fi module and personal computer. The proposed system accesses the information which is monitored by the use of sensors. The accumulated data is then processed by Arduino Controller. By employing IoT, the collected data is uploaded to the cloud which can be further accessed by the concerned people to monitor water health.

Keywords: Carbon Dioxide (CO2), Internet of things (IoT), Arduino, Sensors, Wi-Fi and Thing Speak.

I. INTRODUCTION

Water has been an essential part of human lives since the beginning. No life can survive without water on this planet. It is getting more and more polluted due to industrialization, urbanization and unhealthy agricultural practices. The proposed project tries to present a smart device for water quality monitoring using an IoT environment. It is a self sustaining, stand alone system which uses solar energy. The acquired values from sensors can be processed by the microcontroller and is sent to the cloud through the Wi-Fi module (ESP 8266) over the Internet. This data is then received by the user terminal owned by the concerned consumers. This data can also be displayed on the Mobile and Web applications.

II. RELATED WORK

Nikhil Kedia [1] entitled "Water Quality Monitoring for Rural Areas-A Sensor Cloud Based Economical Project". This highlights water quality monitoring methods, sensors, embedded design, and information dissipation procedure, role of government, network operator and villagers in ensuring proper information dissipation. It also explores the Sensor Cloud domain.

Jing [2] designed a wireless remote monitoring system for water supply based on GPRS using PIC microcontroller. The PC management software is developed using VC++6.0 software platform.

Vijayakumar and Ramya [3] designed a real-time water quality monitoring system in IoT environment. The system consists of several sensors to measure water parameters and the raspberry PI B+ model as a core controller.

In this research [4] the solar panel is polycrystalline type are to be used with 12V 250mA 3W as source.

As we can see, the above projects use different kinds of microcontroller boards as well as various methods to process and send the data over the internet. The proposed project uses an Arduino board which makes it much easier to program and implement. It is cost effective. Also, it employs a solar panel to make it a standalone system capable of working for longer hours and hence is energy efficient.

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III. PROPOSED SYSTEM

3.1 System Overview

The system consists of Arduino, microcontroller, different type of sensors like Water level, ph level, Temperature, Conductivity, Carbon Dioxide (CO2) level & Turbidity. The Arduino is the main processor of the system which control and process the data generated by the sensors. It is powered by rechargeable batteries which draw power from the Solar Panel. When sunlight falls on the photovoltaic cells it converts the incoming photonic energy to electrical energy and hence charges the batteries. A battery charging module is wired in series to keep the charging voltage in check. A Wi-Fi module is connected to the Arduino device which helps to transfer the data to the cloud over internet. Data is retrieved by the users on their computers via Thing Speak. The sensors measure the water quality and help to determine whether the water is useful for drinking or for any agricultural purposes.

Fig 1. Block diagram

3.2 Working of Arduino

The Arduino UNO Microcontroller board serves as the processing unit of our project. It is based on the ATmega328P. It consists of 14 digital I/O pins, 6 analog pins, a 16 MHz quartz crystal, a USB connection, a power jack, an ICSP header and a reset button. Arduino Software (IDE) is the software platform used to program this microcontroller board. The Uno board is the first in a series of USB Arduino board, and the reference model for the Arduino platform.

3.2 Working of Sensors

3.2.1 Turbidity Sensor

Turbidity is the cloudiness or haziness of a fluid which is produced by a large number of independent particles that are generally invisible to the visible eye. Turbidity is the main criteria to measure the quality of water. The light that is scattered due to the suspended solids in water is measured by the help of this sensor. When the amount of total suspended solids (TSS) in water increases

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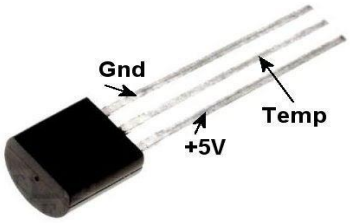
simultaneously the water's turbidity also increases. The sensor uses light to detect suspended particles in water by calibrating the light transmittance and scattering rate and it changes with the quality of total suspended solids (TSS) in water. When the TTS increases by the way the liquid turbidity level also increases. The analog and digitized signal result modes are given by the liquid sensor.

3.2.2 Temperature Sensor



A temperature sensor detects the hotness or coldness of a body. Temperature sensors usually measure temperature by sensing some change in a physical characteristic of the measuring device or material. The LM35 series are precision integrated-circuit temperature sensors, whose output voltage is linearly proportional to the Celsius temperature. The temperature sensor is used to correct the variations in the voltage as the differential voltage changes with temperature.

3.2.3 Conductivity Sensor

Analog electrical conductivity meter is specially used to measure the electrical conductivity of aqueous solution, and then to evaluate the water quality, which is often used in water culture, environmental water detection and other fields. Conductivity is the reciprocal of the resistance, which is related to the ability of the material to carry the current. In the liquid, the reciprocal of the resistance, the conductivity, is the measure of its ability to conduct electricity. Conductivity is an important parameter of water quality. It can reflect the extent of electrolytes present in water.

3.2.4 Carbon Dioxide Sensor

A carbon dioxide sensor or CO_2 sensor is an instrument for the measurement of carbon dioxide gas. CO2 Sensor can be deployed in either soil or water for long-term for the continuous monitoring of atmospheric or dissolved CO2.

3.2.5 pH Sensor

pH is a measure of acidity and/or alkalinity of a solution and ranges from 0 to 14. The pH indicates the concentration of hydrogen [H] + ions present in certain solutions. The sensor measures the potential difference between two electrodes: a reference electrode (silver / silver chloride) and a glass electrode that is sensitive to hydrogen ion.

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3.2.6 Water Level Sensor

Water level sensor is an easy-to-use, cost-effective high level/drop recognition sensor, which is obtained by having a series of parallel wires exposed traces measured droplets/water volume in order to determine the water level.

3.2.7 Wi-Fi Shield

ESP8266 is a Wi-Fi chip which allows to either host or offload data from application to processor. It provides for complete and contained information transfer.

3.3 THE HARDWARE SETUP

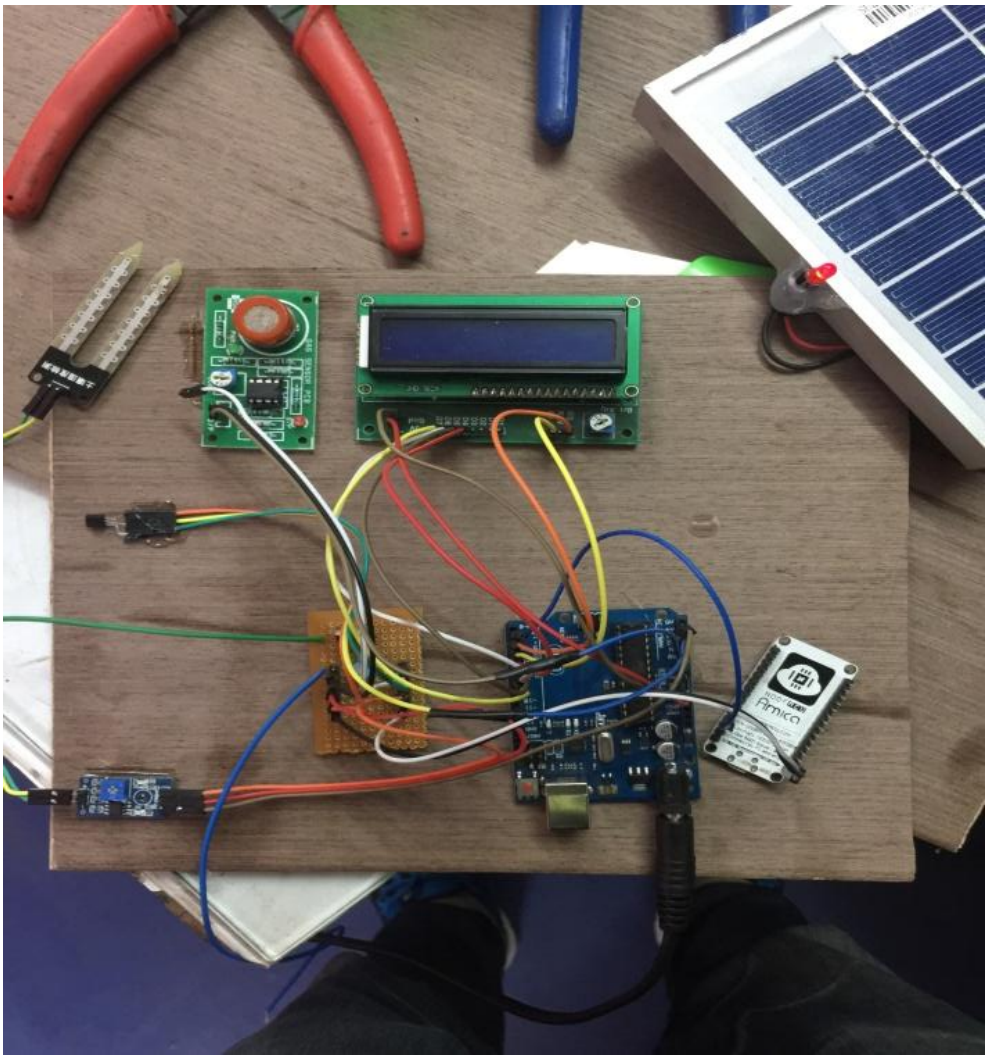

Fig 2. Hardware setup

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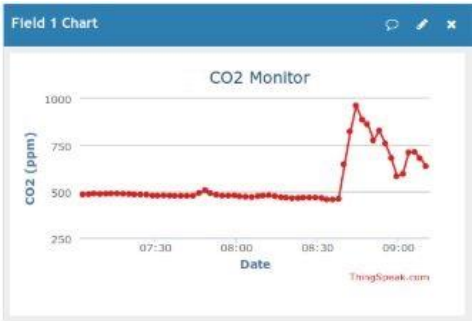
IV. HARDWARE AND SOFTWARE REQUIREMENTS

Table: 4.1

HARDWARE REQUIREMENT	SOFTWARE REQUIREMENT
1. Turbidity sensor 2. Temperature sensor 3. Conductivity sensor 4. Carbon dioxide sensor 5. pH level sensor 6. Water level sensor 7. Arduino UNO 8. Battery charging board 9. Solar panel (5-6V) 10. Wi-Fi shield 11. Batteries	1. Arduino IDE 2. Thing Speak

V. RESULT

After logging onto Thing Speak, the registered users can access the data. The water parameters are displayed in real time. To determine the water quality the sensors are put to test for 2 samples of water. One is the normal tap water and the other contains a test solvent which makes the sample unfit for drinking. Analyzing the output of the 3 sensors the ambient temperature was found out to be 32-34 degree Celsius. The CO2 levels in the second sample were found out to be more as compared to the first one. The water level sensor measures the evaporation levels of water from the reference level of the vessel.



VI. CONCLUSION

Water monitoring system is one of the most pressing needs even today. Despite the fact that there are potentially many methods to evaluate water safety, finding a simple, rapid, versatile, and inexpensive method to check the water quality is still a great challenge. The proposed project is a standalone, robust, reliable, low cost water quality monitoring system using Arduino microcontroller board powered by solar panels in IoT environment.

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