



IMPLEMENTATION OF SENSOR BASED WATER QUALITY MONITORING SYSTEM USING WIRELESS TECHNOLOGY AND SOLAR POWER

¹B. Pavan Kumar, ²Prof. Dr. B. CHANDRA MOHAN REDDY M.Tech., Ph.D,

¹PG Scholar, ²Controller of the Examination, Jawaharlal Nehru Technological University Anantapur,

^{1,2}Department of Mechanical Engineering,

¹JNTUA College of Engineering Anantapur, ²Jawaharlal Technological University Anantapur, Andhra Pradesh, India

Abstract: The main purpose of this project is to monitor water quality using solar energy. Water is an essential life resource for all living things on earth. Water quality plays an important role in health problems for humans, plants and organisms on earth. The main sources of water are rain and rivers etc. Rainwater that flows on land contains not only beneficial components but also many harmful components. Therefore, monitoring water is very important. To monitor water quality in different locations as a real-time application, nodes and base stations are connected using wireless technology such as Arduino Nano. Data collected from various sensors on the node side, such as pH, total dissolved solids (TDS) and temperature, are transmitted to the base station via wireless technology. Data collected from remote locations can be displayed in a visual format. Keywords; Water quality, PH, TDS, solar panel, arduino nano, LCD, wireless technology (WSN)

1. INTRODUCTION

By 2020, 74% of the world's population will have access to a safely managed drinking water supply, and 26% of the world's population will have more than 50 diseases caused by drinking polluted water, which causes 80% of illnesses and 50% of children deaths because of Poor drinking water. However, water pollution causes water-related diseases such as diarrhea, skin diseases and malnutrition. To make it easy to monitor water quality, you can easily analyze some important factors in water and take preventive measures to maintain its quality. These systems can record various environmental parameters from water with the help of various sensors. Temperature, potential of hydrogen, total dissolved solids, TEMPARATURE, etc. All sensors are connected to Arduino Nano. The Arduino Nano has various ways to communicate with a PC, another Arduino, or other microcontroller. Data collected from the sensors is transmitted to the base station through wireless channels. A base station is typically a PC with a graphical user interface (GUI) that allows users to analyze water quality. Collected data can be analyzed by various simulation tools for future responses and actions.

Existing System

Basically, there are many parameters that are needed to be measured for water quality analysis. However, proposed system measures the key water parameters:

- Water's pH value.
- TEMPARATURE of the water.
- Conductivity

Existing system has Zigbee is a wireless protocol and It is not designed to support higher data rates, expensive and Security and compatibility. Data visualisation is relatively poor.

2. LITERATURE REVIEW

• Water Quality Monitoring System Based on IOT by Vaishnavi V. Daigavane and Dr. M.A Gaikwad, published on Number 5 (2017). This paper represents the to monitor the quality of water over different sites as a real time application. a base station and distributed sensor like (temperature, ph,flow sensors) are suggested. . A WSN technology like arduino is used to connect the nodes and base station. external power supply is used as main supply. Battery are not used in this system. The advantage in this system is no carbon emission etc. this system is not suitable for remote locations because of nodes usually distribute in remote places, and the total expense in connecting all these nodes is unbearable. Another method is to use battery only. The advantages are obvious, but batteries

have limited lifespan and cannot stand for a long time. Replacing depleted batteries regularly is inconvenient. To avoid unnecessary work and make the system more flexible to deploy, solar panel is to use in this system to supply power for the sensor node, together with the battery to recharge when solar power is not enough, such as night.

- Design and Development of Water Quality Monitoring System in IOT by M. Joseph Vishal Kumar, Krishna Samalla published on February 2019. This paper represent the to monitor the quality of water over different sites as a real time application. a base station and distributed sensor like (temperature, ph,flow sensors) are suggested. A WSN technology like Raspberry pi is used to connect the nodes and base station . external power supply is used as main supply. Battery are not used in this system. The advantage in this system is no carbon emission etc. this system is not suitable for remote locations.

- Solar Powered Water Quality Monitoring system using wireless Sensor Network by Kulkarni Amruta M. Dept. of E&TC, P.R.E.C., Loni University of Pune. Turkane Satish M. Head Dept. of E&TC, P.R.E.C., Loni University of Pune. Published in 06 July 2016. This paper represent the to monitor the quality of water over different sites as a real time application. a base station and distributed sensor nodes(temperature, dissolved oxygen,redox sensors) are suggested. A WSN technology like zigbee is used to connect the nodes and base station . The advantage in this system is low power consumption, no carbon emission, more flexible to deploy at remote site and so on.

- ‘IOT Based Water Quality Monitoring System ’ by AYTI BHATT, JIGNESH PATOLIYA published in the year 2016, This paper, represent the design of IOT based water quality monitoring system that monitor the quality of water in real time. This system consists some 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 this 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

- Ch. Pavankumar, S. Praveenkumar they propose a system which monitor air and water quality based on Bluetooth platform. The system consists of various sensors like temperature, humidity, gas and salt. Also they used ultrasonic sensor to measure underwater obstacle. In this system the all sensors data are directly send to user’s mobile phone by using Bluetooth. For monitoring air and water quality they used android application which will access all sensors parameters from the system

- ‘An IoT Based System for Water Quality Monitoring’ by Aaina Venkateswaran, Harsha Menda P, Prof Priti Badar published in 2017, This paper presents a smart water quality monitoring system. The system consists of several sensors which are used for measuring physical and chemical parameters of water. The parameters such as temperature, dissolved oxygen, turbidity, conductivity, dissolved oxygen of the water can be measured. Using this system a person can detect pollutants from a water body from anywhere in the world.

3. IMPLEMENTATION

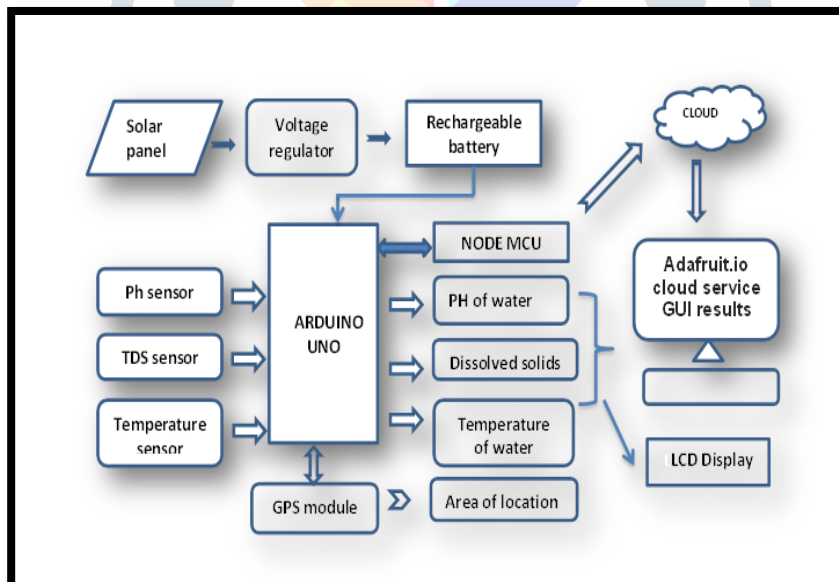


Figure3.1 The overall block diagram of system operation.

Proposed System:

The proposed system uses three sensors which are dissolved oxygen, temperature, Ph and one gps module, microcontroller unit as the main processing module and one data transmission module ESP8266 Wi-Fi module (NodeMCU). The microcontroller unit is a significant part of the system developed for water quality measurement because The Arduino uno consumes low power, and it is a small size, where the size is a good use for a crucial point-of-sale technology criterion. Among four sensors, two of the sensors collect the data in the form of analog signals; the MCU has an on-chip ADC that translates the sensor analog signals into the digital format for further study. So, to get this analog output from the sensor, the sensor's analog output will be connected to the MCU's analog pins.

Whereas the other two sensors output directly connected to the digital pins of the MCU units. All the sensors data processed by the MCU and updated to the Adafruit io server using the WiFi data communication module ESP8266 (NodeMCU) to the central server.

Solar Panel Interfacing:

The proposed system, the sensor node is installed in a remote location, so power supply is a very important issue. Wired connections are not usually possible, as the nodes are spread out far from the city. Another way is to use batteries. While the benefits are obvious, the battery has a limited lifespan and cannot be used for long periods of time. To save unnecessary effort and make the system more flexible, the system uses solar panels to power the sensor nodes and batteries for charging when solar energy is not enough, such as night.

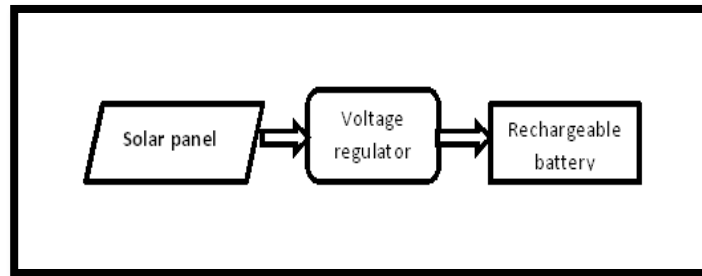


Figure3.2 Solar panel interfacing

Sensors: Sensors are transducer devices used to detect environmental events or changes and provide a corresponding electrical output. The most important characteristics of sens accuracy, resolution, linearity and speed. Sensor calibration improves sensor performance. Removing structural errors in the sensor output can improve performance. Structural errors can be found by taking the difference between the sensor's measured output and the expected output.

The above reproducibility errors calculated during calibration are corrected in real time during the measurements performed by the sensor.

Temperature sensor:

Water Temperature indicates how water is hot or cold. The range of DS18B20 temperature sensor is -55 to $+125$ °C. This temperature sensor is digital type which gives accurate reading.



Figure3.3 DS18B20 Temperature sensor

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 arduino. The normal range of pH is 6 to 8.5.



Figure3.4 Ph sensor

Tds sensor:

A TDS sensor is a device used to indicate the Total Dissolved Solids in a solution, usually water. Since dissolved ionized solids, such as salts and minerals, increase the conductivity of a solution, a TDS meter measures the conductivity of the solution and estimates the TDS from that reading. dissolved ionized solids, such as salts and minerals, increase the conductivity of a solution, a TDS meter measures the conductivity of the solution and estimates the TDS from that reading. The normal range of tds sensor is 50-500.

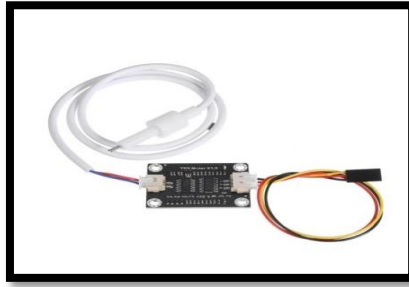


Figure3.5 Total dissolved solids (TDS) sensor

NEO-6M GPS Module:

The NEO-6M GPS module is a GPS receiver that can locate all locations on Earth as it is able to track approximately 22 satellites. It consists of a high-performance u-blox 6 positioning engine. Measuring 16 x 12.2 x 2.4 mm, its compact architecture along with its low power consumption makes it a good choice for IoT projects. Overall it is a good cost-effective GPS receiver.

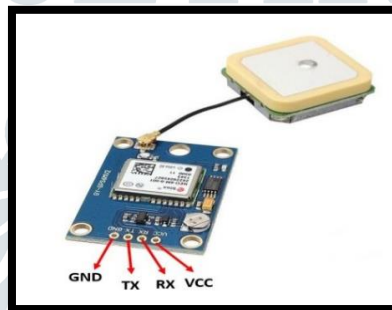


Figure3.6 NEO-6M GPS Module

ARDUINO UNO:

Arduino is a microcontroller board based on the ATmega328P. It has 14 digital input/output pins (of which 6 can be used as PWM outputs), 6 analog inputs, a 16 MHz quartz crystal, a USB connection, a power jack, an ICSP header and a reset button. It contains everything needed to support the microcontroller. Arduino Software (IDE) were the reference versions of Arduino, now evolved to newer releases. The Uno board is the first in a series of USB Arduino boards, and the reference model for the Arduino platform; for an extensive list of current, past or outdated boards see the Arduino index of boards



Figure3.7 Arduino uno

NODE MCU (wifi module):

The ESP8266 Wi-Fi Module is a self-contained SOC with integrated TCP/IP protocol stack that can give any microcontroller access to your Wi-Fi network. The ESP8266 is capable of either hosting an application or offloading all Wi-Fi networking functions from

another application processor. Each ESP8266 module comes pre-programmed with an AT command set firmware. The ESP8266 module is an extremely cost-effective board with a huge, and ever growing, community.



Figure3.8 Node mcu

LCD Display:

LCD (Liquid Crystal Display) is a type of flat panel display which uses liquid crystals in its primary form of operation. LEDs have a large and varying set of use cases for consumers and businesses, as they can be commonly found in smartphones, televisions, computer monitors and instrument panels.

Adafruit io server:

adafruit io is an IoT data collection application for analysis of various sensors, e.g. Ph, Tds, voltage, temperature, etc. The data collector collects data from edge node devices (this happens with the NodeMCU/ESP8266) and also allows the data to be modified for historical data analysis in a software environment. First, the user must log in with details on his/her server. The channel containing data fields and a status field is the primary component of Adafruit io activity. After a Adafruit io channel has been developed, data is modified, processed, and interpreted with MATLAB code, and the data is reacted by tweets and other alert.

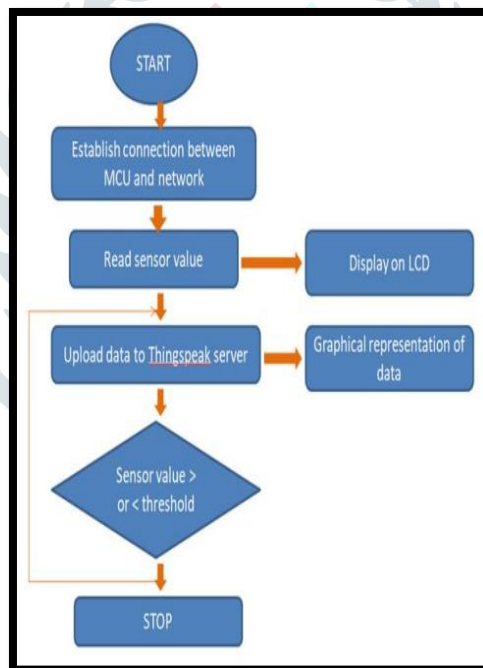


Figure3.9 Data flow diagram

5.RESULTS

Authorized users can access the data by logging into the ThingSpeak website. After entering your registered user ID and password, you will be directed to a web page where real-time parameters are displayed in graph form. Improve your water quality monitoring system reference for more efficient and reliable results.

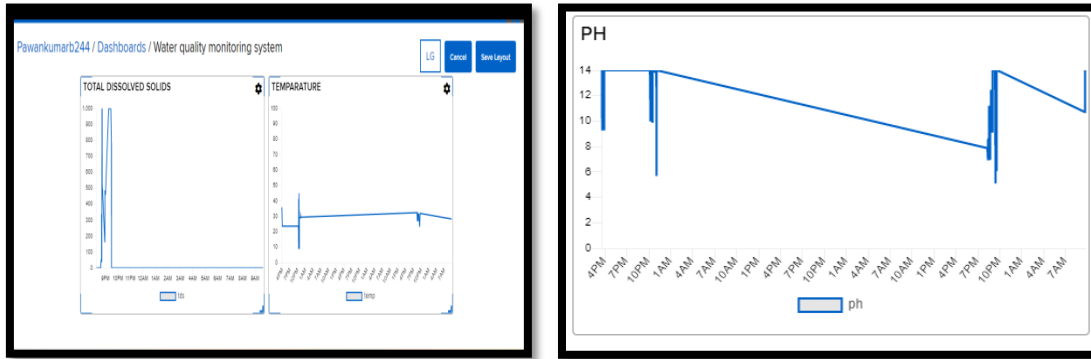


Figure5.1 Data from various sensors is represented graphically

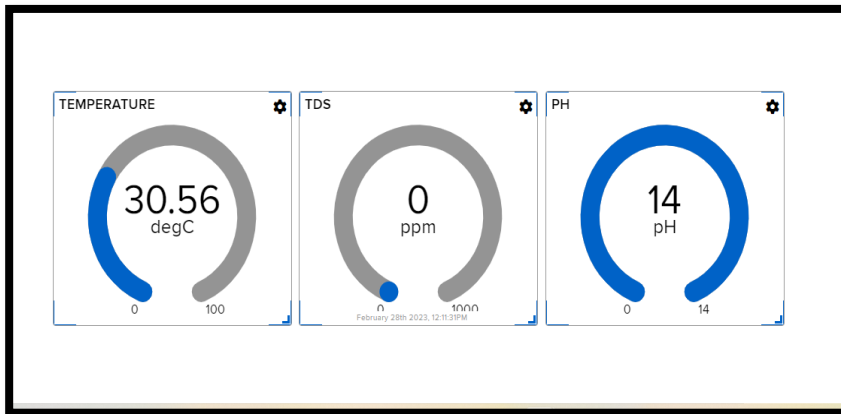


Figure5.2 Data from various sensors is represented in digital

Table 5.1 Standard sensor ranges and their respective unit of measures displayed Sensor values are displayed.

PARAMETERS MONITORED	RANGE	UNITS
Temperature	0-100	°C.
Total dissolved solids	0-1000	PPM
Ph	0-14	Ph
GPS	Global	Latitude & Longitude.

Table 5.2 Data from various waters and sensors

WATER TYPE	PH	TDS	Temperature
Filter water	8.3	92	28
Normal water	7.6	282	26.94
Salt water	7.8	850	27.31
Sea water	8.9	above 1000	31

CONCLUSION

The system proposed in this paper is an efficient, inexpensive IoT solution for real-time water quality monitoring. The developed system having Arduino Uno and NodeMCU are interfaced with several sensors successfully. An efficient algorithm is developed in

real-time, to track water quality. The measured quality range ph value ranges from 6.5 to 8.5. The measured quality range of Total dissolved solids ranges from 50 to 500. The measured quality range of temperature sensor ranges from of 20–50 °C to prevent the growth of the organism. A web-based server i.e., Adafruit io is used to monitor the parameters such as pH value, the TEMPERATURE of the water total dissolved solids in the water, Further, these measured parameters also monitored in Adafruit io mobile server. Also, this work needs to be carried out to analyse several other parameters like dissolved oxygen, free residual chlorine, nitrates, and water level in the water.

Future Enhancement

This project has much potential for future enhancement. As the new technologies are easily available as open source, we can add many new features to it. Few of the enhancements we can work on are as follows:

- Add Dissolved Oxygen Sensor can be used in Aquaculture.
- Add chemical sensor can be used in Hydroponics.
- Improve Data Validation Process.
- Improve Data Visualization for better understanding.

REFERENCES

- Vaishnavi V. Daigavane and Dr. M.A Gaikwad, *Advances in Wireless and Mobile Communications*. ISSN 0973-6972 Volume 10, Number 5 (2017), pp. 1107-1116 © Research India Publications.
- M. Joseph Vishal Kumar, Krishna Samalla, “Design and Development of Water Quality Monitoring System in IOT”, *International Journal of Recent Technology and Engineering (IJRTE)* ISSN: 2277-3878, Volume-7, Issue-5S3, February 2019.
- Kulkarni Amruta M. Dept. of E&TC, P.R.E.C., Loni University of Pune. Turkane Satish M. Head Dept. of E&TC, P.R.E.C., Loni University of Pune. Published in 06 July 2016.
- IOT Based Water Quality Monitoring System ’ by AYTI BHATT, JIGNESH PATOLIYA published in the year 2016.
- Ch. Pavankumar, S. Praveenkumar they propose a system which monitor air and water quality based on Bluetooth platform.
- An IoT Based System for Water Quality Monitoring’ by Aaina Venkateswaran, Harsha Menda P, Prof Priti Badar published in 2017.
- P.V. Sagar, Ch. Mukesh, N.R. Moparthy, “Water Quality Monitoring System Using IOT”, 4th international conference of advances in electrical, electronics, Information, communication and Bio-Informatics, October-2018.
- S.Shetty, S.Srinivasan, Sindhu.S, Veena K P, Gururaj H L, “ Portable H2O Quality Monitoring and Cloud Reporting System”, National Conference on Engineering Innovations and Solutions, (NCEIS) *International Journal of Scientific Research in Computer Science, Engineering and Information Technology*, Volume 4, Issue 6,2018.
- Kirthana.K, Mythrayee.G, Punithajothi. N, D. Murugesan, “Real Time Water Quality Monitoring System using solar power supply and IOT based system” Jignesh Patoliya, *International Research Journal of Modernization in Engineering Technology and Science*, Volume:03, Issue:03, March-2021.
- Automated Water Quality Monitoring, Field Manual(1999), Ministry of Environment Lands, and Parks, Water Management Branch for the Aquatic Inventory Task Force Resources Inventory Committee, The Province of British Columbia, and Canada.
- “Web Based Water Quality Monitoring with Sensor Network: Employing ZigBee and WiMax Technologies” by Steven Silva, Hoang N ghia Nguyen, Valentina Tiporlini and Kamal Alameh, 978-1-4577-1169-5/11/\$26.00 ©2011 IEEE.