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AUTOMATED WATER FILTRATION SYSTEM USING REAL-TIME MONITORING

Devanna.H[1] Meghana.ch[2] Chandana.B[3] Manoj Kumar.G[4] Santosh.B[5]

[1]Associate professor, Department of ECE, Vignan's Institute of Information Technology (Autonomous), Visakhapatnam, India.
[2]Student of ECE, Vignan's Institute of Information Technology (Autonomous), Visakhapatnam, India.
[3]Student of ECE, Vignan's Institute of Information Technology (Autonomous), Visakhapatnam, India.
[4]Student of ECE, Vignan's Institute of Information Technology (Autonomous), Visakhapatnam, India.
[5]Student of ECE, Vignan's Institute of Information Technology (Autonomous), Visakhapatnam, India.

*[1]E-mail:drhdevanna@gmail.com *[2]meghanachintala25@gmail.com
*[3]chandanabudda2@gmail.com

*[4]manojkumarginni30@gmail.com *[5]santoshborugadda946@gmail.com

Abstract:
This paper's primary objective is to design an automated filtration system for water that uses real-time control and monitoring. The proposed method measures the TDS values of aquatic source before and after filtering. With the help of Wi-Fi module and a GSM module, the system gathers and uploads real-time sensor values via an IoT. It recognizes the industrial wastewater, sends notifications via SMS, and manages the gate valves. If the TDS value is out of the range then water will be send to water filter for water purification process. Filtered water will be sent to Water Bodies which is safe to aquatic life. In order to introduce a revolution in waste water treatment, this is a lower budget framework project for making the users comfortable and also protect the Aquaculture. This product helps to lead a healthy environment. Access to clean and sustainable water sources is an imperative global concern as we face mounting challenges related to water pollution, scarcity, and environmental degradation.This abstract introduces an innovative approach to address these challenges through the creation of an Automated Water Filtration System with real-time monitoring capabilities specifically designed for water bodies such as lakes, rivers, and ponds.

Keywords:
Wi-Fi module,GSM module(Global system for mobile communication),TDS(Totaldissolvedsolids),IoT(Interet of Things).

1. Introduction

Among the most valuable natural resources that have been given to humanity is water. It is infinite and required resource that sustains life, ecosystems and human activities. Freshwater makes up less than 3% of all resources on Earth,

even though it is the most abundant at 75%. Furthermore, over 65% of water is frozen in ice caps and glaciers, where it is melting more quickly than ever before as a result of real climate change. So the purity of water is a important factor that plays a major role for healthy and sustainable environment. The main factor affecting the quality of water is pollution. Drinking water can become contaminated by pollution and become unsafe for human consumption. In addition, it degrades aquatic ecosystems and lowers the standard of living for those who depend on them. India is a developing nation where it involves in daily activities such as urbanization, pollution, industry, and natural events affect the quality of water by altering different characteristics that affect the water's fitness for general use or human consumption [1]. Beyond those, most frequently the chemical wastes from human operations like mining, the extraction of crude oil, and industrial wastes wind up in rivers,lakes, and other water sources, altering the composition and characteristics of these waterways. Water pollution is also caused by a number of human activities and products, including endocrine disruptors (plasticizer, pesticides, and antimicrobials), pharmaceuticals (antibiotics &drugs), personal care products (moisturizers,sunscreens & beauty products), artificial sweeteners, and herbicides [5]. Mixing industrial waste water with natural water bodies is a main cause of contamination of water resources. Two Indian industrial cities, Kanpur and Agra, might be used as models in this regard. These two cities are located on the banks of the Ganges and Yamuna, two significant rivers that cut across the plains of India. Due to the presence of significant leather manufacturing plants in both of these locations, untreated industrial waste is being discharged into water bodies. This has a significant effect on aquatic life. It degrades the quality of the water that is readily available, contaminating it with hazardous chemical extracts and rendering it unfit for residential use. These waters then find their way to homes or farms, where they are utilized for drinking, watering crops, feeding cattle, and other household needs. Drinking this kind of water might be fatal or have extremely harmful effects on your health[2].Water quality needs must be continuously monitored over an extended period of time in order to supply industrial production, agricultural irrigation, and human demands. This requires the development of an effective and practical approach. More study has, however, concentrated on effective methods for identifying important water quality measures and low-cost methods of detecting and analyzing them because different water quality parameters have different constraints in certain studies [3]. The best use of available water resources and trustworthy water quality monitoring are therefore crucial, particularly in light of potential future water shortage issues. Regretfully, improved water quality monitoring technologies that can cover large regions with low operating costs and provide data over an extended period of time are still required [4]. The growth of IoT technology has made it feasible to directly acquire data from devices for centralized processing and delivery to other locations where data is needed. By connecting different control and sensing devices to mobile terminals and monitoring systems, IoT technology offers a workable option for data exchange and unified management of diverse equipment supply chains. Numerous goals can be accomplished with this, including intelligent optimization and real-time online monitoring and control from a distance [6]. Water treatment plants are now required in these types of units in order to remove dangerous pollutants from waste water before it enters waterways. The suggested system will use a TDS sensor to track the water flow's TDS value. Smart systems that can monitor water quality and possess the intelligence to extract valuable data can be developed through the usage of IoT platforms. This is an inexpensive and dependable solution [7]. Such methods are no longer thought to be effective This research suggests employing inexpensive, low-power, and tiny in-pipe sensors to monitor the quality of water supplied to customers, recognizing the obvious need for

a change in the present monitoring paradigm [8]. Systems for managing and monitoring water have been presented in a variety of ways to benefit various industries. A few of the suggested systems sought to lower the quantity of waste water, increase the effectiveness of the water distribution systems, and alert the community to any significant water-related environmental problems. These systems were part of the roadmap for developing long-term, sustainable Internet of Things solutions.

2.Literature Review

1.Ranya m. M. Salem, m. Sabry saraya ,and amr m. T. Ali proposed) An industrial cloud-based Internet of Things system that tracks temperature, pH, and other environmental parameters in real time, as well as collecting and uploading real-time sensor readings to the cloud through an IIoT Wi-Fi Module 2,develops a portable, movable, affordable, versatile, and easily configurable system that is capable of monitoring and controlling industrial wastewater.

2.Vaishnavi V Daigavane, Dr. M.A Gaikwad IOT-Based Water Quality Monitoring System is used for detecting the more parameters for most secure purpose Using GSM network and more sensors it will be more convenient & flexible to check the water's purity .3.Karthick. T, Gayatri Dutt, Tarunjot Singh Kohli, Snigdha Pandey proposed in 2018 Water Quality Forecast and Smart Water Quality Monitoring System in IoT Environment to compare the results with WHO standards using machine learning &decisions are made In this the results generated from the different sensors are compared with standard values AND decisions making is done.

4.AnuradhaT, Bhakti, Chaitra R, Pooja D proposed in 2018, an IoT-based low-cost system was developed to analyze temperature, pH, turbidity, and TDS levels in real-time water quality monitoring. The primary emphasis is on assessing the water's quality and suitability for supporting the life of sand plants.

5.S.Noorjannah Ibrahim, M.S.Lokman Hakim, A.L.Asnawi and N.A. Malik proposed In 2019, an LDR-Sensor-Based Automated Water Tank Filtration System 1. A microscopic pump that controls the flow of water to the filter by pumping out of the tank an automatic water filtering system can be created with a low-powered microcontroller, such as the Arduino Uno. Because it enables users to keep an eye on the water quality, the device is helpful.

6.Ajith B, Manimegalai R proposed. Water Quality Monitoring in Real-Time in an IoT Environment in 2020 to use Arduino controller to determine the water's quality using different sensors. The system is inexpensive, effectively transfer and control signals, and has the ability to automatically monitor the quality of the water.

7.Monira Mukta et al introduced an IoT-based (SWQM) system that measures temperature, pH, electric conductivity, and turbidity using sensors attached to an Arduino. A NET desktop application receives the data and cross-references it with WHO guidelines. By using a fast forest binary classifier, the system can easily differentiates the water samples based on measured parameters. The objective is to develop a trustworthy IoT platform for ongoing monitoring, and the SWQM system performs accurately, opening the door for future real-time water quality monitoring with more features.

3.Existing methodology

The manual collection of water samples and the manual reading of the sensors are the traditional means of monitoring inlet wastewater. Laboratory analytical techniques are then employed to enable early detection and warning in the event of illegal inlet wastewater to the sewage plant. These techniques are no longer regarded as efficient since they are laborious to implement. All the existing automated water filtration systems includes only pH sensors which tells about the acidity and alkalinity of the solution but does not tells about the water's composition of both organic and inorganic substances and some existing methodologies just monitors only the data but do not filter it out and dump into the water bodies. The current system is limited to monitoring industrial

wastewater discharged into the wastewater treatment plant. It consists of an analog pH electrode for monitoring wastewater intake pH and a pH transmitter with display for displaying pH data. The employee keeps an eye on the display during his shift to see if the numbers are within the range, meaning there is industrial effluent present, or if they are larger than 9, meaning there is none. For this reason, the employee will physically shut the inflow entrance valves, diverting the water to industrial wastewater treatment facilities instead of the waterbodies. Throughout his shift, the worker watches the display to check if the numbers are within the range, indicating the presence of industrial effluent, or larger than 9, indicating its absence. Because of this, the worker will physically close the inflow entrance valves, directing the water away from the waterbodies and toward industrial wastewater treatment facilities.

There is no any filtering technology included in the existing systems which just only monitors the data but does not filters out the waste water. The existing methodologies doesn't include GSM module which do not sends the message of the readings in case of no availability of wifi connection and the new version of blynk 2.0 may not be used to send the data readings in the avail of wifi connection. The existing methodologies needs a lot of manual work which decreases the work efficiency.

4.Proposed technique

In our methodology, the proposed system consists of TDS sensor,GSM module,2 channel relay module and lcd display. Current initiatives use a pH sensor to assess the acidity or alkalinity and hydrogen content of water, however this is insufficient to determine the water's purity. So we used TDS sensors instead of pH sensor which measures the total dissolved solids in water, including salts, minerals, and other compounds.This provides a more comprehensive assessment of water quality compared to pH alone. TDS levels can indicates the value of dissolved solids in parts per million(ppm) which says purity of water in detail. High TDS levels may suggest contamination of harmful substances like lead, mercury, cadmium, chromium and other pharmaceutical residues. while low TDS levels may indicate pure water which indicates there is no presence of larger amounts of dissolved solids. This information is crucial for applications such as drinking water,water quality monitoring and for additional purposes where water quality directly affects aquatic and human life.As project is real time monitoring after measuring the TDS values ,the measured values has to be sent to the mobile phone through GSM900A module,where GSM stands for Global System for Mobile communication.It operates between frequency 0f 900MHz to 1800MHz. It is utilized for data transmission, text messaging (SMS), and voice calls among other mobile communication services. Mobile phones and other handheld devices that support the GSM standard can operate on this frequency band to connect to cellular networks GSM 900A can be utilized in various IoT applications where devices need to communicate over long distances. This includes applications such as remote monitoring, asset tracking, smart metering, and environmental sensing. GSM 900A provides reliable connectivity in areas where other wireless technologies may have limited coverage and also through blynk app.The main purpose to use GSM module in project data has to be transmit regularly in the case of interrupted signals and poor network in remote areas ,GSM will take charge and proceeds sending values to the mobile regularly and also the system takes a comparison of TDS values that if the values are out of range it notifies us through mobile phone.These measured TDS values has been sent to lcd display that people can watch readings.Here we used 2 channel relay module to control the flow of water where 2 DC motors get connected into relay module.Based on TDS readings if they are out of range motor 1 starts working and water directs through it which it goes under filtration.If the values are in range then the

water is directly discharged into the water bodies.

5.Proposed model

5.1.Block Diagram of our work :`

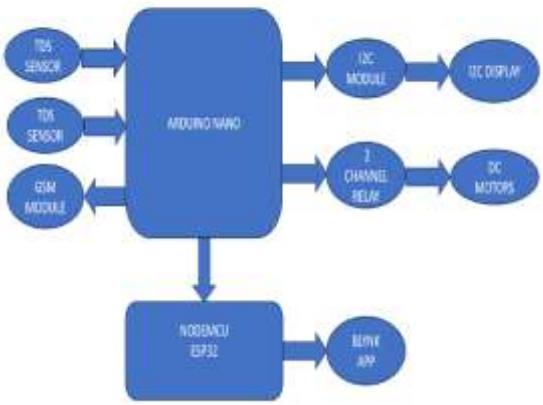


Fig: Block diagram of automated water filtration system using real time monitoring

The block diagram of the project illustrates the fundamental components and connections of the automated water filtration system using real time monitoring. The components include Arduino Nano, TDS sensors, i2c module, i2c display, GSM module, two channel relay and DC Motors along with the blynk app. TDS sensor ,GSM module ,i2c display, two channel relay, DC motors and i2c module are interfaced with arduino Nano whereas blink app is interface with node MCU. The idea behind utilizing both an Arduino Nano and a Node MCU is that connecting every component to a single microcontroller can result in slower processing and a higher risk of a reset. So we use two microcontrollers arduino Nano and node MCU so that there is no chance of reset and it can work properly. TDS sensor are used to measure the water quality in PPM where as GSM module is used to send the data of the TDS sensor to the mobile phones when there is no available is used to convert the serial data into parallel data and IC to i2c display is used to display relay and DC motor. Initially, we will use a TDS sensor to measure the water's purity. Then, we will feed the Arduino Nano the results of the TDS sensor measurement. Whereas Arduino Nano process the data and send to the I2C modular this i2c module will send the data to i2c display which displays values on it and also at the same time the values were given to the mobile phone either through GSM 900 a module or through the blink app and at the same time if the values were in the range then the water is directly discharge into the water bodies which is operated by the two channel relay which controls the DC motor.Two channel relay decides which DC motor should be on and where the water has to be let. As we know that the node MCU consist of a inbuilt by 5 module in it and for the purpose of sending messages to the mobile phone through Wi-Fi we will connect the blink app to this node MCU. Hence the proposed technology is an advanced version when compared to traditional techniques as we use new version of Blynk app and TDS sensors instead of pH sensors and also after filtering out if the TDS values are not in the range again then the water is sent back to the filtration process again which is the refiltration of the water which helps in the much more purification the water leading to a healthy environment for all the living organisms.

5.2.Flow chart of our work

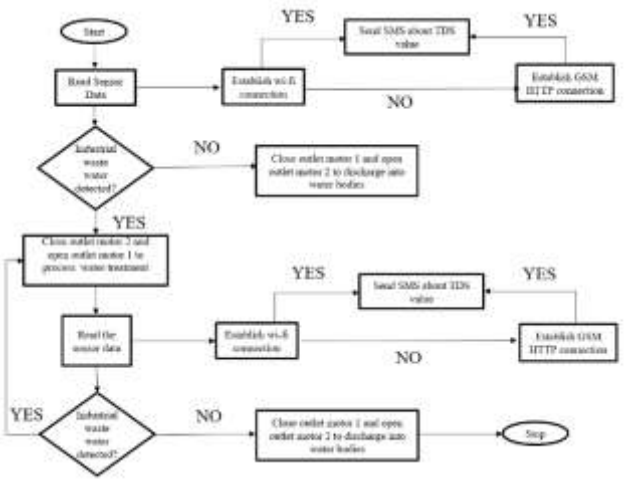


Fig: Flow chart of automated water filtration system using real time monitoring

1.Starts the process of measuring TDS values of water.
2.Reads the given TDS sensor data. The sensor data will send to mobile phone if wife connection is established.If not GSM module comes into progress and helps sending data to mobile phone.
3.With the help of measured TDS values if there is no industrial waste water detected, the 2-channel relay module closes outlet valve 1 and opens outlet valve 1 which pumps the water with the help of motor and it get release to water bodies.
4.If industrial waste water detected, where TDS values are out of range, 2-channel relay module closes outlet valve 2 and opens outlet valve 1 for water treatment which water has to go under filtration.
5.Repeats step 2 process.
6.If the filtered water values are in range, filtered water get discharge to water bodies
7.Stop.
Its about the flowchart of the automated water filtration system using real time monitoring.

5.3.Components

NODEMCU (ESP32):

- Dual-core processor
- built-in Wi-Fi and Bluetooth
- GPIO pins for sensor interfacing
- low power consumption.
- It is the central processing unit and communication hub. Its WI-FI capability enables real-time data transmission, while GPIO pins facilitate sensor integration.

TDS Sensor (SEN0244):

- Operating Voltage: 5V
- Measurement Range:0 to 5000 parts per million (ppm).
- Acceptable Range: 150-250.
- Ideal Range for Freshwater: 50-150
- A tool for determining the amount of dissolved solids in a liquid is a TDS (Total Dissolved Solids) sensor

2-Channel Relay Module (JQC-3FF-S-Z):

- Operating Voltage: 5V
- Relay modules, such as the NodeMCU, are low-power microcontrollers that can be used to control high-power devices.Two independent electrical circuits can be controlled by the 2-channel relay module. Relay modules are controlled by the NodeMCU using the program that is imported into it.

900A GSM Module:

- Power Supply Voltage: 3.6V
- This likely refers to a GSM module that enables communication via cellular networks. It could be used for remote monitoring and control of devices through SMS or data communication. This module is used to send the pH readings to the user.

ARDUINO NANO:

- Power supply voltage: 5V
- It provides input and output pins that allow easy interfacing and used to collect and display data which is given by TDS sensors.
- It also responsible for the on/off condition for motors based on sensor values.

I2C Module:

- Power Supply Voltage: 5V
- An integrated PCF8574 I2C chip in the I2C module translates I2C serial data to parallel data for the LCD display.
- I2C modules have four output pins, and they get a 5V supply via VCC and GND connecting to the Arduino Nano's GND.

I2C DISPLAY:

- I2C (Inter-Integrated Circuit) is a communication protocol, and an I2C display typically refers to an LCD or OLED display that readily interfaces via the I2C protocol with other devices. It's commonly used for displaying information in projects where a visual output is required. This is used to know the change in pH values which are displayed in I2C display.

DC Motor:

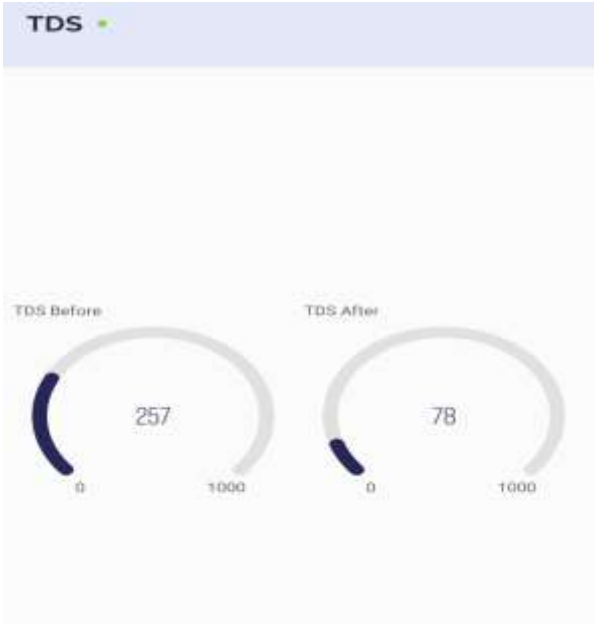
Electrical energy is transformed into mechanical energy by DC motors. They are widely used in robotics, automation, and various electronic projects for tasks like moving parts or driving wheels. These are used to regulate the water flow to the filtration tank or the water bodies based on the pH value range. The relay module is used to control this motor.

TDS ranges:

Condition	Values
Ideal	0-150 ppm
Recommended	150-250 ppm
Unacceptable	>250 ppm

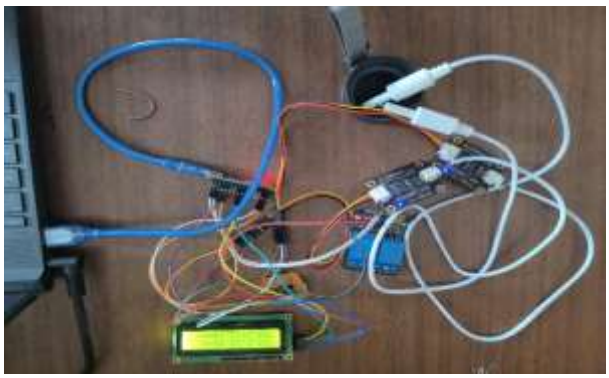
6. Results

The TDS levels before and after filtering are 257 and 78, respectively, according to the conclusions of the discussion above. The values prior to filtration are 257 and the after filtration 78. Additionally, the TDS sensor's values were shown on the i2c display and the user device (mobile phone) via the Blynk program. In the event if Wi-Fi is unavailable, the GSM 900A module come into action & helps in display the data in user device. The water is sent through a filtration process if the display readings are outside of the acceptable range, and we saw the water's final TDS value after filtration is displayed as 78.



7. Conclusion

The successful implementation of automated water filtration system using real time monitoring represent a significant milestone in water quality monitoring and filtration technology. Through meticulous design and integration of components such as TDS (totally dissolved solids) sensors, along with I2C module, i2c display, two channel relay, DC motors the system demonstrates its capability to collect accurate data and visually inspect water quality. Furthermore, the functionality of the system via the Blynk application ensures user-friendly operation and real-time monitoring capabilities. Overall, this project underscores the potential of water filtration systems in advancing sustainable water management practices and ecological conservation efforts.



Conflicts of Interest

The authors declare no conflict of interest

Author contributions

Guideance and support by Devanna H,Conceptualization by Meghana ch,Product design by Chandana B,Implemation and validation by Manojkumar G and Santosh B.

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