EGS PILLAY ENGINEERING COLLEGE
NAGAPATTINAM(AUTONOMOUS)

DEPARTMENT OF INFORMATION TECHNOLOGY

INTERNET OF THINGS

MINI PROJECT

WATER QUALITY MONITORING SYSTEM

AN APPLICATION OF SMART MONITORING

SUBMITTED BY

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ABSTRACT

According to the WHO in 2022, unsafe water leads to 1.7 million mortalities and 4 billion cases of waterborne diseases globally. Monitoring quality of potable water is a difficult task → Integration of IoT, sensors, and communication systems → to transform the water quality monitoring system. The key objective of this work is to develop an IoT-based water quality monitoring system to measure physiochemical parameters for a rural drinking water distribution system.AquaNet → sensors, a powerful controller, a seamless communication network, a fixed sink node (an access point), and a personalized anchored float (buoyage). It measures → temperature, conductivity, turbidity, and pH in a predetermined time interval. Cloud storage for collected data → implemented in the water tanks of TWAD (Tamilnadu Water Supply and Drainage Board)

PROBLEM STATEMENT

- To develop an efficient and real-time Internet of Things (IoT)-based system for monitoring and ensuring the quality of water in rural tanks.
- The system aims to enhance water management and safety in rural areas by providing continuous insights into water quality parameters, thereby promoting safe water use for agriculture, drinking, and other needs.

Project Goals:

- Continuous Monitoring: Implement IoT-enabled sensors to continuously monitor key water quality parameters such as pH levels, turbidity, dissolved oxygen, temperature, and chemical contaminants.
- Data Analytics and Alerts: Use cloud-based systems to collect, analyze, and store data in real-time, providing alerts and insights when water quality deteriorates beyond safe thresholds.
- Low-Cost Implementation: Design the system to be affordable and scalable for rural communities, considering budget constraints and the need for low-maintenance solutions.
- Community Empowerment: Involve local communities and stakeholders in understanding water quality metrics and using the data to take corrective actions, such as tank cleaning, filtering, or water treatment.

CONTRIBUTION AND OBJECTIVE

OBJECTIVE

To develop an IoT-based water quality monitoring system for a rural drinking water distribution system sensors, a powerful controller, a seamless communication network, a fixed access point and a personalized anchored float (buoyage).

To measure critical quality parameters including temperature, conductivity, turbidity, and pH

CONTRIBUTION

A real-time WQM system is proposed for rural areas

A method is developed to direct a suitable warning message to the participants when the observed CQPs diverge from WHO standards resource utilization

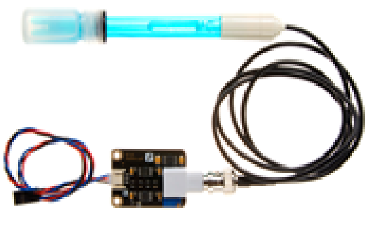
INTRODUCTION

Water is the international solvent.Safe water service is a safely distributed drinking water. Quality monitoring is an important part of the potable water supply and management system.

In this process, parameters at designated places are measured at predefined intervals to provide data that may be used to reveal present conditions, create trends, etc.Measuring and collecting water quality data is a challenging problemMonitoring of water quality provides a pragmatic basis by measuring temporal and spatial physiochemical data.It sets and drives thresholds for predicting water quality conditions, and water quality trends, and enabling obligatory statistics for the validation and standardization of models.Climate variability worsens the issue further.

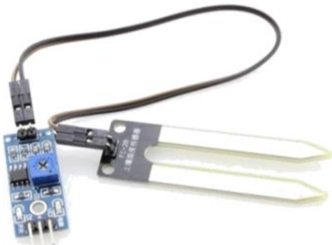
HARDWARE COMPONENTS

TI LM35 - Temperature sensor



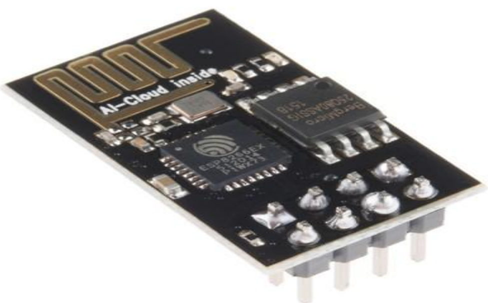
(a) DFRobot SEN0161- pH sensor

(b) DFRobot SEN0189 - Turbidity sensor



(c) SparkFun YL 69 -Conductivity sensor

Arduino UNO



ESP8266 transceiver unit

I. Arduino UNO

It is a microcontroller board developed by Arduino.cc and based on Atmega328.Electronic devices are becoming compact, flexible and cheap that are capable of doing more function as compared to their predecessors that happened to cover more space, turned out costly with the ability to perform fewer functions. It is an open-source platform, means the boards and software are readily available and anyone can modify and optimize the boards for better functionality.The microcontroller was introduced in the electronics industry with the purpose of making our tasks easy that come with even a remote connection with automation in any way.Microcontrollers are widely used in embedded systems and make devices work according to our needs and requirements. We have already discussed the controllers like 8051, Atmega16, Atmega328 and PIC16F877.Arduino Uno is a very valuable addition in the electronics that consists of USB interface, 14 digital I/O pins, 6 analog pins, and Atmega328 microcontroller. It also supports serial communication using Tx and Rx pins.

2. TI LM35 - Temperature sensor

The TI LM35 is a precision temperature sensor that provides a linear analog output proportional to temperature. It is calibrated directly in Celsius, offering a simple output of 10 mV per degree Celsius without requiring any external calibration or adjustments. The sensor operates over a wide temperature range, from -55°C to 150°C, with high accuracy typically within ±0.5°C at room temperature. Its low power consumption and compact TO-92 package make it ideal for a variety of applications, including HVAC systems, environmental monitoring, and microcontroller-based temperature sensing. The LM35 does not require additional signal conditioning, making integration straightforward. Furthermore, it operates with a single power supply, ranging from 4V to 30V, enhancing its versatility in embedded systems.

3. DFRobot SEN0161- pH sensor

The DFRobot SEN0161 is a pH sensor kit designed for accurate pH measurement in water quality testing and environmental monitoring. It is ideal for applications such as aquaponics, hydroponics, and chemical experiments. The sensor provides a high-precision analog output proportional to the pH value, with a measurement range of 0-14 pH and accuracy within ±0.1 pH under standard conditions.The sensor features a durable glass electrode and includes a waterproof BNC connector for ease of integration. It is compatible with microcontrollers like Arduino and supports a 5V operating voltage, making it user-friendly for DIY projects. The kit often includes calibration powders to adjust the sensor for accurate readings.

4. DFRobot SEN0189 - Turbidity sensor

The **DFRobot SEN0189 Turbidity Sensor** is a sensor designed to measure the clarity or turbidity of water. It uses optical principles to determine the amount of light scattered by suspended particles in water, providing an analog output proportional to the turbidity level. This makes it suitable for applications such as water quality monitoring, environmental analysis, and aquaponics systems.

5. SparkFun YL 69 -Conductivity sensor

The **SparkFun YL-69 Soil Moisture Sensor** is a sensor module designed to measure the conductivity of soil, which is proportional to its moisture content. It helps determine how much water is present in the soil, making it useful for agriculture, gardening, and environmental monitoring**.** The YL-69 sensor is sensitive to corrosion over time, particularly in highly conductive or acidic soil, so it’s often recommended for experimental or short-term applications. For long-term use, capacitive soil moisture sensors are preferred.

6.ESP8266 transceiver unit

The **ESP8266** is a low-cost Wi-Fi transceiver module widely used in IoT (Internet of Things) applications. It integrates a powerful 32-bit processor, Wi-Fi capabilities, and GPIO pins, making it a versatile solution for projects requiring wireless connectivity. The ESP8266 is highly popular due to its combination of affordability, ease of use, and robust features, making it a go-to choice for IoT projects.

SOFTWARE

I. ARDUINO IDE

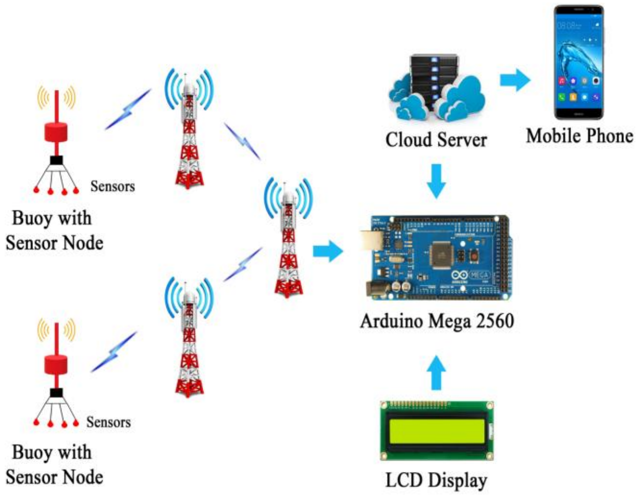
The Arduino Integrated Development Environment - or Arduino Software (IDE) - contains a text editor for writing code, a message area, a text console, a toolbar with buttons for commonfunctions and a series of menus. It connects to the Arduino and Genuino hardware to upload programs and communicate with them. It can be programmed using C and C++ language.

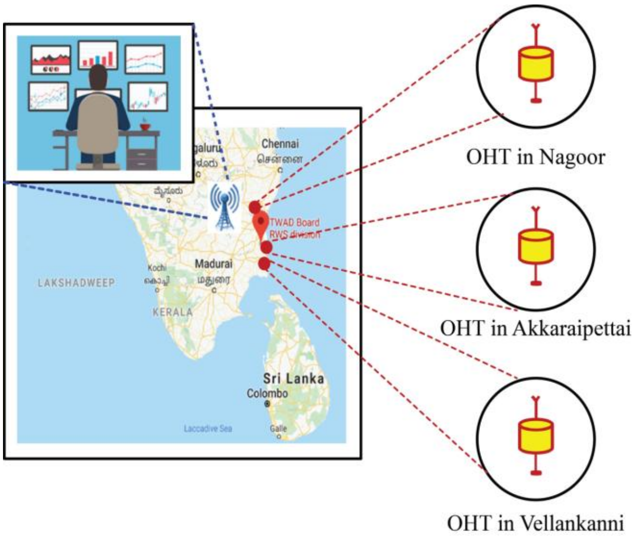
Programs written using Arduino Software (IDE) are called **sketches**. These sketches are written in the text editor and are saved with the file extension .ino. The editor has features for cutting/pasting and for searching/replacing text. The message area gives feedback while saving and exporting and also displays errors. The console displays text output by the Arduino Software (IDE), including complete error messages and other information. The bottom righthand corner of the window displays the configured board and serial port. The toolbar buttons allow you to verify and upload programs, create, open, and save sketches, and open theserial monitor.

The Arduino IDE supplies a software library from the Wiring project, which provides many common input and output procedures. User-written code only requires two basic functions, for starting the sketch and the main program loop, that are compiled and linked with a program stub *main()* into an executable cyclic executive program with the GNU toolchain, also included with the IDE distribution.[6] The Arduino IDE employs the program *avrdude* to convert the executable code into a text file in hexadecimal encoding that is loaded into the Arduino board by a loader program in the board's firmware.[7] By default, avrdude is used as the uploading tool to flash the user code onto official Arduino boards

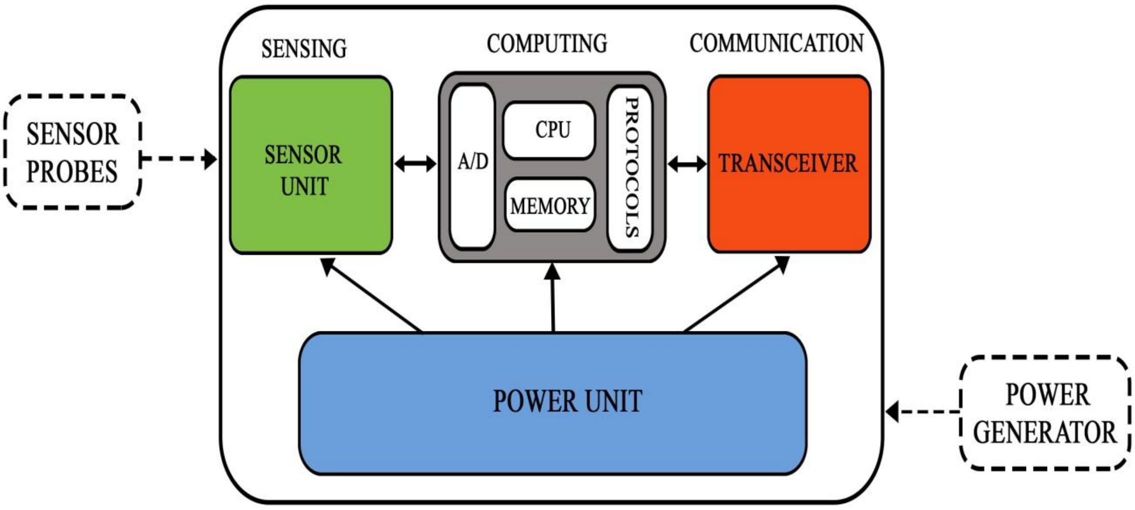
PROPOSED WORK

There are two functional components in this project. They are the moisture sensors module and the motor driver for motor pump. Thus the Arduino Board is programmed using the Arduino IDEsoftware. The function of the moisture sensor is to sense the temperature content present in the soil, and also it measure moisture level in the soil. The motor driver interrupts the signal to, water pump supplies water to the plants. This project uses microcontroller Arduino Uno board to controls the motor and monitor soil moisture. Follow the schematic to connect the Arduino to the motor driver, and the driver to the water pump. The motor can be driven by a 5 volt battery, we can also supplies power from external source or from Arduino board. The Arduino Board is programmed using the Arduino IDE software





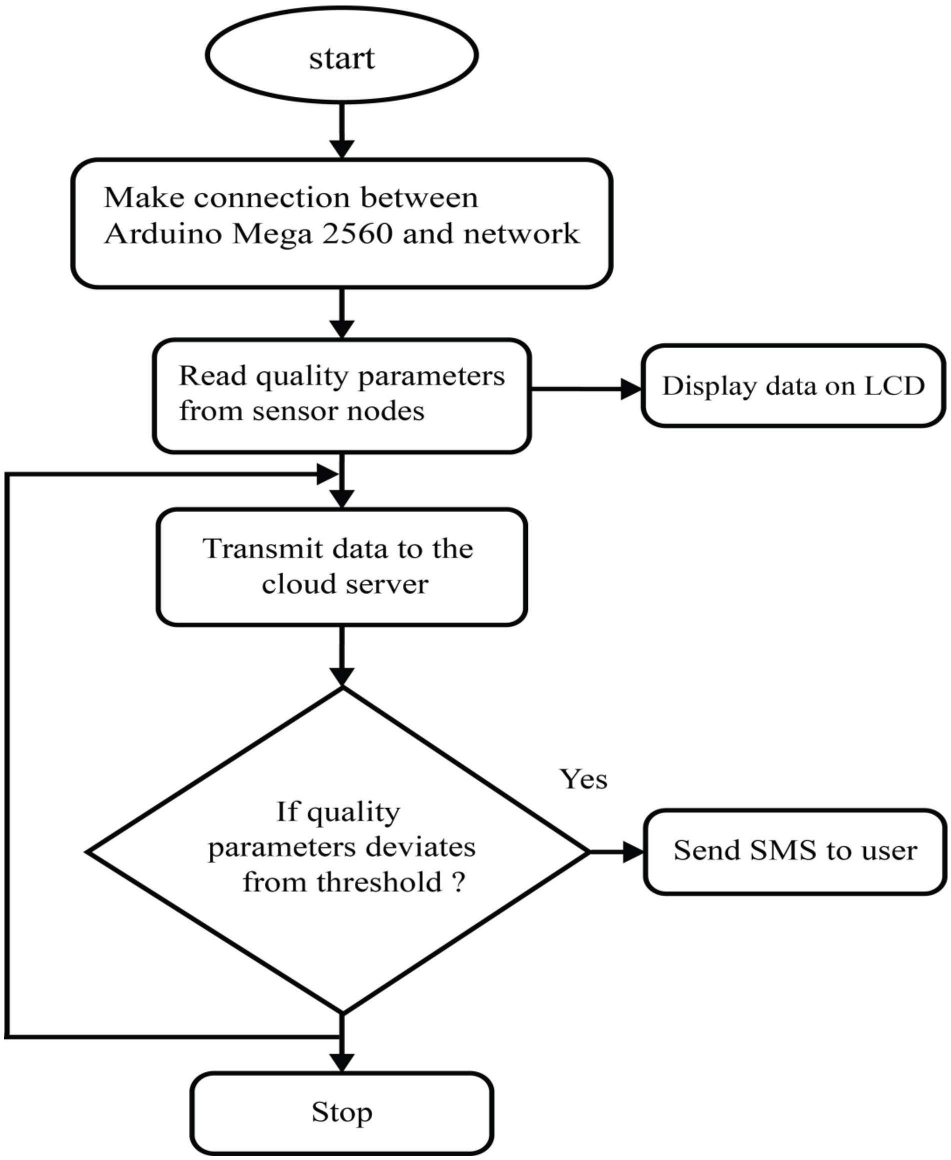
WORKING OF SENSOR



Basic hardware architecture of a sensing node

This diagram proposed the working of sensors and how interacts with cloud server system

FLOW CHART



This flowchart illustrates a process for monitoring and managing environmental or system parameters using an Arduino Mega 2560. Below are the steps explained briefly:

1. **Start**: The system initialization begins.
2. **Establish a network connection**: A connection between the Arduino Mega 2560 and the network is established, ensuring communication capability.
3. **Read sensor data**: Quality parameters are collected from the connected sensor nodes.
4. **Display on LCD**: The collected data is displayed on an LCD screen for local monitoring.

5. **Transmit data to the cloud**: The data is sent to a cloud server for storage, analysis, or remote monitoring.
6. **Check for threshold violations**: The system evaluates whether any parameters deviate from predefined threshold values.
7. **Send SMS alerts**: If a deviation is detected, an SMS is sent to notify the user about the anomaly.
8. **Stop**: If no further processing is required, the process ends. Otherwise, it loops back to continuously monitor and transmit data.

IMPLEMENTATIONS – ARDUINO IDE

```
#include <Wire.h>

#include <LiquidCrystal.h>



// LCD Configuration

LiquidCrystal lcd(12, 11, 5, 4, 3, 2);



// Pin Configuration

const int pH_pin = A0;       // pH sensor connected to Analog pin A0

const int turbidity_pin = A1; // Turbidity sensor connected to Analog pin A1

const int temp_pin = A2;     // LM35 sensor connected to Analog pin A2



// Variables to store sensor data

float pHValue = 0.0;

float turbidityValue = 0.0;

float temperature = 0.0;



// Function to read temperature
```

```
float readTemperature() {
  int tempValue = analogRead(temp_pin);
  float voltage = tempValue * (5.0 / 1023.0); // Convert ADC value to voltage
  return voltage * 100;                    // Convert voltage to Celsius
}

// Function to read pH
float readPH() {
  int sensorValue = analogRead(pH_pin);
  return (sensorValue * 5.0 / 1023.0) * 3.5; // Scale to pH range
}

// Function to read turbidity
float readTurbidity() {
  int sensorValue = analogRead(turbidity_pin);
  return (sensorValue * 5.0 / 1023.0) * 100; // Scale to NTU
}

// Setup function
void setup() {
  lcd.begin(16, 2);        // Initialize LCD
  Serial.begin(9600);      // Initialize Serial communication
  lcd.print("Water Quality"); // Display system name
```

```
  delay(2000);
  lcd.clear();
}

// Loop function
void loop() {
  // Read sensor values
  pHValue = readPH();
  turbidityValue = readTurbidity();
  temperature = readTemperature();

  // Display data on LCD
  lcd.setCursor(0, 0);
  lcd.print("pH: ");
  lcd.print(pHValue, 2);
  lcd.setCursor(0, 1);
  lcd.print("Temp: ");
  lcd.print(temperature, 1);
  lcd.print("C");

  delay(2000); // Delay to show pH

  lcd.setCursor(0, 0);
```

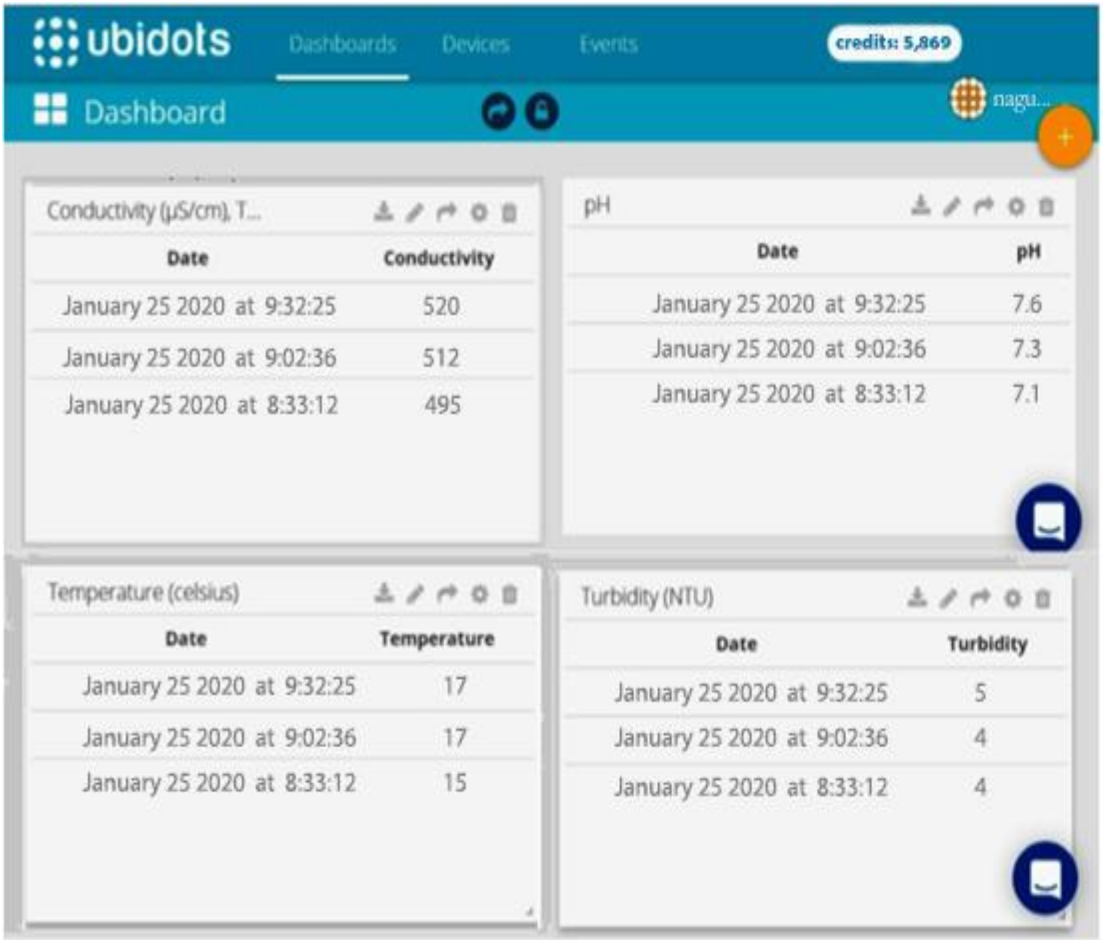
```
  lcd.print("Turb: ");
  lcd.print(turbidityValue, 1);
  lcd.print(" NTU");
  lcd.setCursor(0, 1);
  lcd.print("                "); // Clear second row
  delay(2000);

  // Send data to Serial (for ESP8266/cloud upload)
  Serial.print("pH: ");
  Serial.print(pHValue, 2);
  Serial.print(" | Temp: ");
  Serial.print(temperature, 1);
  Serial.print("C | Turbidity: ");
  Serial.print(turbidityValue, 1);
  Serial.println(" NTU");

  // Insert logic to send data to a cloud server here, if needed.

  delay(3000); // Wait for 3 seconds before next reading
}
```

DEMO

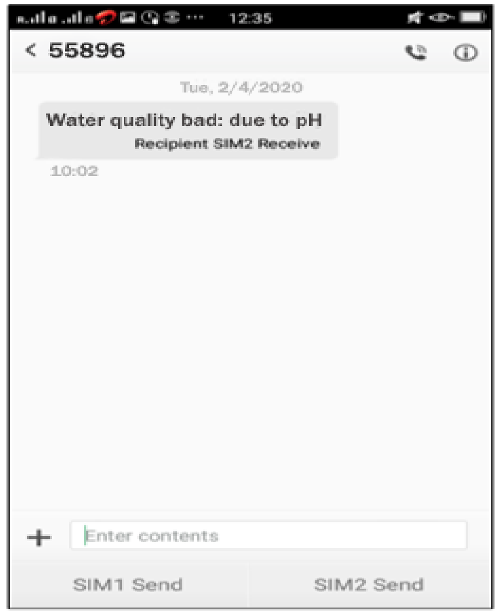


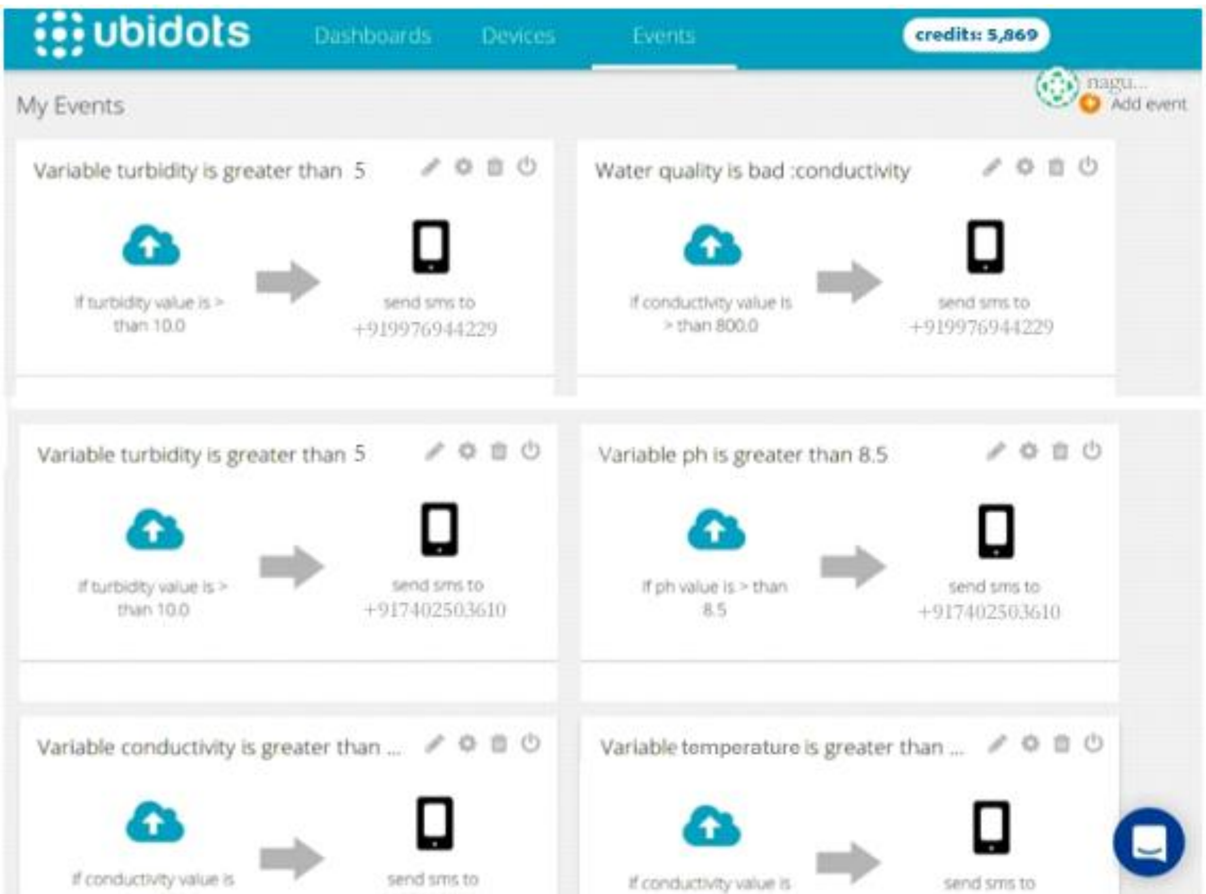
This result directly extracted from the app which connected with cloud server

OWT	Conductivity			Temperature		
	AquaNet	Horiba	Diff	AquaNet	Horiba	Diff
1	523	527	-4	17.6	17.2	0.4
2	527	526	1	17.2	16.9	0.3
3	487	486	1	16.5	16.2	0.3
	Average Difference		-0.67	Average Difference		-0.34

RESULT AND DISCUSSION


ubidots
Dashboards
Devices
Events
credits: 5,869
Dashboard
Conductivity (µS/cm)
Turbidity (NTU)
pH
Temperature
2020/01/25
pH 7.1
temp 17°


12:35
55896
Tue, 2/4/2020
Water quality bad: due to pH
Recipient SIM2 Receive
10:02
Enter contents
SIM1 Send
SIM2 Send


ubidots
Dashboards
Devices
Events
credits: 5,869
My Events
Add event
Variable turbidity is greater than 5
If turbidity value is > than 10.0
send sms to +919976944229
Water quality is bad :conductivity
If conductivity value is > than 800.0
send sms to +919976944229
Variable turbidity is greater than 5
If turbidity value is > than 10.0
send sms to +917402503610
Variable ph is greater than 8.5
If ph value is > than 8.5
send sms to +917402503610
Variable conductivity is greater than ...
If conductivity value is
send sms to
Variable temperature is greater than ...
If conductivity value is
send sms to

CONCLUSION

The water quality monitoring system based on sensors like the pH sensor, turbidity sensor, and temperature sensor is a practical approach to assessing environmental and industrial water conditions. By leveraging Arduino and transceiver units such as the ESP8266, it facilitates real-time data acquisition, processing, and remote transmission. This system is highly adaptable, allowing for local display on an LCD and integration with cloud platforms for remote monitoring and threshold-based alerts (e.g., SMS notifications).The use of automation ensures accurate and consistent monitoring, reducing manual effort and human error. The modular design allows for future expansion, such as integrating additional sensors (e.g., conductivity or dissolved oxygen sensors) to capture more parameters.This project is vital for applications in agriculture, drinking water safety, and industrial processes, promoting sustainable resource management and compliance with environmental standards.

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