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IOT Based Water Quality Monitoring System using Thingspeak

Mr. Rajshekar G [a], Miss. Mahek Sultana [b], Miss. Maliha Nishat [c], Mr. Md Maqsood Ali [d], Mr. Md Saqlain Saeed [e]

[a] *Professor, Guru Nanak Dev Engineering College, Bidar-585403, Karnataka, INDIA*
[b,c,d,e] *UG Student, Guru Nanak Dev Engineering College, Bidar-585403, Karnataka, INDIA*

A B S T R A C T

Monitoring water quality and its proper management is crucial for any industrial and economic application. Global water scarcity requires sustainable solutions to optimize its use. The Internet of Things provides a robust and cost-effective solution for real-time monitoring of various water parameters. The aim of the paper is to implement an intelligent water quality monitoring system with the help of the Internet of Things. The proposed system was successfully implemented for the determination of pH, Temperature,Turbidity, TDS, flow and water level for a given sample. The data obtained from the sensors is uploaded to the ThingSpeak dashboard for online monitoring purposes.

Keywords:— Sensors, Water Quality, Water parameters, Temperature, turbidity, pH, Arduino UNO, thingspeak.com

1. INTRODUCTION

"Water quality" is a term used herein to refer to the suitability of water to sustain various uses or processes. Each particular use will have certain requirements for the physical, chemical or biological properties of the water; for example, limits on concentrations of toxic substances for use in drinking water or restrictions on temperatures and pH ranges for water supporting invertebrate communities. As a result, water quality can be defined by a number of variables that limit water consumption. Efforts to improve or maintain a certain water quality often compromise between the quality and quantity requirements of different users. It is increasingly recognized that natural ecosystems have a legitimate place in considering water quality management options. Both for their intrinsic value and because they are sensitive indicators of changes or deterioration in overall water quality and provide a useful supplement to physical, chemical and other information.

Wi-Fi (short for Wireless Fidelity) is a wireless technology that uses high-frequency data transmission through the air. Wi-Fi transmits data in the 2.4 GHz frequency band. It implements the concept of frequency multiplexing technology. The range of Wi-Fi technology is 40-300 feet.

In this project, a temperature sensor is used to measure the temperature of water. The PH sensor measures the PH of the water and the turbidity sensor measures the amount of light that is scattered by the solids in the water. A soil moisture sensor is used to measure moisture content. All these parameter values are constantly fed as input to the Arduino UNO microcontroller. These parameter values are constantly updated to the ThingSpeak cloud along with the date and time via WI-FI.

ThingSpeak is an open-source Internet of Things (IoT) application and API for storing and retrieving data from things using the HTTP protocol over the Internet or over a local network.

* *Corresponding author.* Tel.: +91-9901321465
E-mail address: mdsaeedsaqlain1234@gmail.com

1.1. Problem Statement

An economical and efficient water quality monitoring system is the most robust impure water implementation. Drinking water could be precious to all people as water managers face greater challenges. These problems arise due to high population, less number of water sources etc.

1.2. Primary Goal

Water quality monitoring by determining pH, turbidity, conductivity and temperature. The Arduino controller used will have access to the sensor data. With the use of IoT, the collected data is analyzed using ThingSpeakand water pollution can be investigated through a rigorous mechanism.

1.3. Motivation

A Safe water is becoming a scarce resource due to the combined effects of increased population, pollution and climate change. Water quality monitoring is therefore paramount, especially for commercial water. Traditional laboratory testing procedures are manual, expensive, time-consuming and lack real-time feedback. Recently developed systems using wireless sensor network (WSN) technology have reported deficiencies in energy management, data security, and communication coverage.

2. INTERNET OF THINGS (IOT)

IoT is a modern communication model of the near future, in which objects of daily life, which are equipped with microcontrollers, digital communication transmitters and receivers, are controlled through appropriate protocols, creating a kind of communication network between each other and with users, and this will make it an integral part of the Internet. The IoT concept aims to popularize the Internet. Furthermore, due to the easy interaction with a wide range of devices such as home applications, CCTV, surveillance sensors, motors, monitors, vehicles, etc. The IoT model is indeed applicable in various fields (household, industrial automation, medical assistance, mobile health care, assistance for the elderly, smart power management, smart grids, automobiles, and others). Currently, this concept is increasingly explained as an environment of connected people with objects, not only M2M, IoT is about joint services based on human and machine communication.

This type of network consists of smart devices, self-contained devices that are able to monitor or communicate with their surroundings. In addition, the term "smart" means that these objects are able to obtain data from the surrounding environment, then process it and communicate (share) with other objects and independently interact with the environment, which depends on data using built-in electronics, software sensors. and actuators and communication skills. In other words, these smart objects that are distributed in the surrounding environment and integrated into various contexts can greatly improve people's interaction with their environment, create applications and services in any part.

3. METHODOLOGY

The system consists of electronic devices, sensors, communication devices and a communication medium. The entire system is shown in the diagramsbelow.

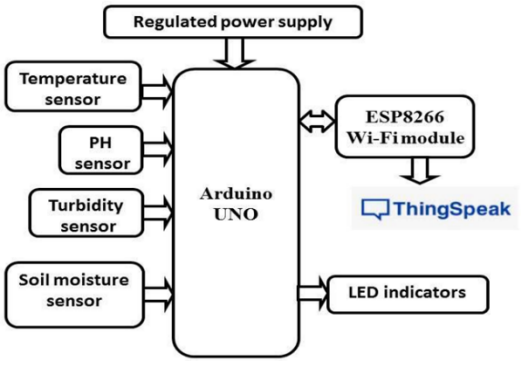

Fig. 1 –Block diagram of IOT Based Water Quality Monitoring System Using ThingSpeak

The main components of this system are:

- **Power Supply**
  A power source is a supply of electrical energy. A device or system that supplies electrical power or another type of power to an output load or group of loads is called a power supply unit or PSU. The term is most often used for electrical power supplies, less often for mechanical, and rarely for others.

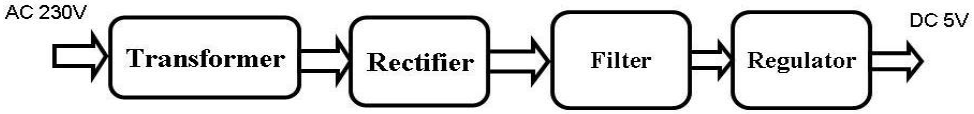

Fig. 2–Regulated Power Supply

- **Arduino UNO**
  The Arduino Uno is a microcontroller board that has an ATmega328 from the AVR family. There are 14 digital input/output pins, 6 analog pins and a 16MHz ceramic resonator. There are many Arduino compatible and Arduino derived boards. Some are functionally equivalent to an Arduino and can be used interchangeably. Many improve the basic Arduino by adding output drivers, often for use in school education, to make it easier to make buggies and small robots. Others are electrically equivalent but change the form factor, sometimes maintaining shield compatibility, sometimes not. Some variants use different processors with different compatibility.

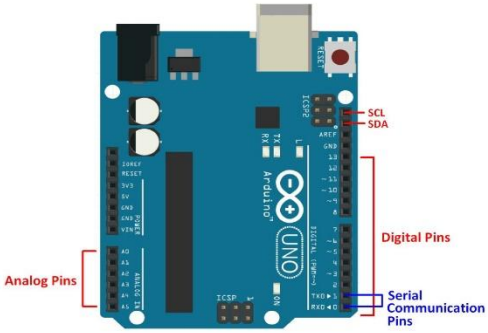

Fig. 3–Arduino UNO

- **pH Sensor**
  The pH sensor helps to measure the acidity or alkalinity of water with a value between 0-14. When the pH value drops below seven, the water becomes more acidic. Any number above seven equals more basic. Each type of pH sensor works differently to measure water quality.

Fig. 4–pH Sensor

- **Temperature Sensor**
  The DS18B20 is a digital temperature sensor that is commonly used in a variety of applications to accurately measure temperature. It is manufactured by Maxim Integrated and is part of their family of 1-Wire devices.

Fig. 5–Temperature Sensor

- **Turbidity Sensor**
  The Arduino Turbidity Sensor is able to detect and verify water quality, it performs turbidity measurements, where it is possible to verify the results using a digital or analog signal next to the corresponding pins in the accompanying electronic module.

Fig. 6–Turbidity Sensor

- **Soil Moisture Sensor**
  The soil moisture sensor consists of two probes that are used to measure the volumetric water content. Two probes allow current to pass through the soil and then obtain a resistance value to measure the moisture value.

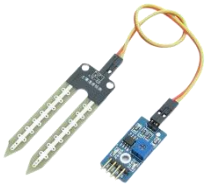

Fig. 7–Soil Moisture Sensor

- **ESP8266 Wi-Fi module**
  The ESP8266 Wi-Fi module is a standalone SOC with an 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 functions from another application processor.

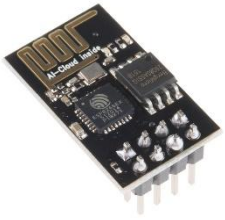

Fig. 8–ESP8266 Wi-Fi module

4. RESULTS

Fig. 9–Final Implemented System

The following results are obtained:

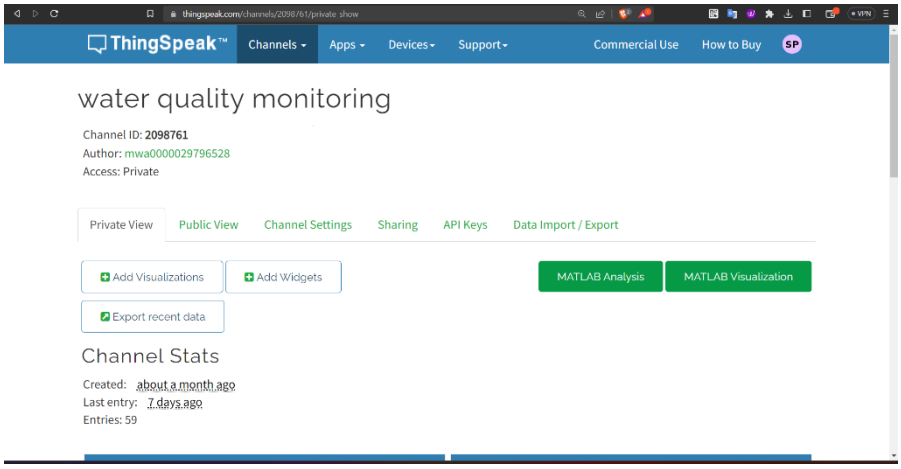

Fig. 10–ThingSpeak channel details

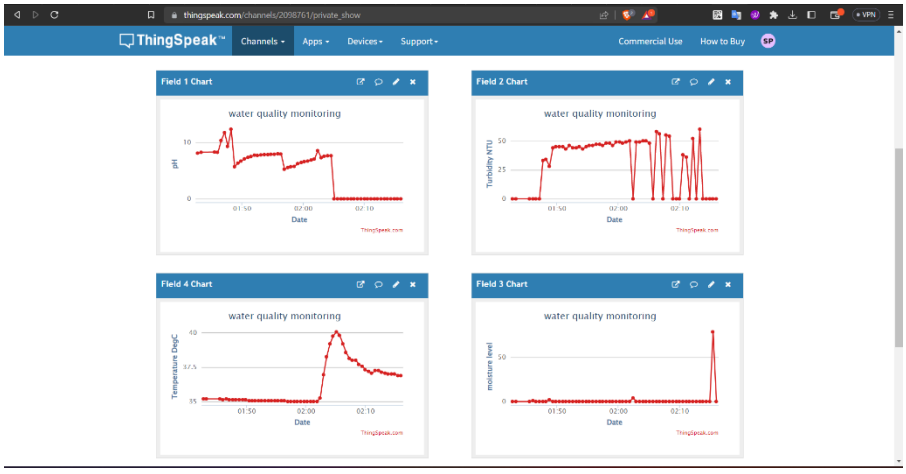

Fig. 11–Output as graphs on ThingSpeak

The Output results can also be downloaded in the CSV format:

Entry ID	ParametersofWater			
	Temperature	***Turbidity***	***pH***	***Moisture***
1	9	5.7	28	2
2	10	6.35	44	0
3	11	6.7	45	0
4	12	7.1	45	0
5	13	7.35	45	0
6	14	7.5	43	0
7	15	7.75	46	0
8	16	7.7	44	0
9	17	7.8	44	0

Table. 1–Monitored results in CSV format

5. CONCLUSION

First, the use of IoT technology makes water quality monitoring more efficient and accurate. The ability to collect real-time data from multiple sensors deployed at different locations allows for comprehensive monitoring and early detection of any water quality issues. This ensures that quick action can be taken to mitigate potential risks and keep the water safe.

Second, as a cloud platform, ThingSpeak provides a user-friendly interface for data visualization and analysis. This allows stakeholders to easily access and interpret the collected data, identifying trends, patterns and anomalies that may affect water quality. The flexibility of the platform allows customization and integration with other tools and systems, improving overall monitoring and management capabilities.

Finally, the continuous monitoring enabled by IoT and ThingSpeak reduces reliance on manual sampling and laboratory testing, resulting in cost savings and improved operational efficiency. With automated data collection and analysis, resources can be more efficiently allocated and preventive measures implemented in a timely manner, thereby minimizing the potential impact of water quality incidents on public health and the environment.

The integration properties of all used hardware components were developed in it. The presence of each module has been carefully reasoned and placed, which contributes to the best functioning of the unit. And with the use of highly advanced integrated circuits with the help of growing technology, the project was successfully implemented. So, the project was successfully designed and tested.

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