ABSTRACT

IOT driven water purity monitoring which identifies and help to solve the problem in quality of the water samples. It is useful to check and monitor the quality of the samples for healthier life. Air pollution monitoring tends to be primarily focused on human health and prolong the earths life and ozone layer, conservation and protection of aquatic environment and keeping the quality check of water for future uses. One of the key ideas in IoT is decentralization. Rather than centralizing compute and storage resources in a single place, they are distributed to where it makes sense. This decentralization was fueled by small low-power microprocessors that could handle the compute needs at the edges of the internet and NAND-based devices which provide fast high-capacity storage in a small space. The input is in the form of samples through sensors which has a digital and analog output. Arduino is the heart of this project which controls the entire process. There are Multi Sensors used to check the quality of the samples at different places. The values are checked, displayed and they are sent to thingspeak and they are displayed on the server. Wi-Fi module connects the whole process to internet and LCD is used for the visual output. The main idea behind the project is to increase the quality of human life and serve the Mankind.

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LIST OF ABBREVATIONS

S.NO	ABBREVATION	EXPANSIONS
1.	LCD	Liquid Crystal Display
2.	IC	Integrated Circuit
3.	LED	Light Emitting Diode
4.	I/O	Input/Output
5.	MHZ	Mega Hertz
6.	KHZ	Kilo Hertz
7.	LF	Low Frequency
8.	HF	High Frequency
9.	UHF	Ultra High Frequency
10.	VLF	Very Low Frequency
11.	PWM	Pulse Width Modulation
12.	RAM	Random Access Memory
13.	HTTP	Hypertext Transfer Protocol
14.	FTP	File Transfer Protocol
15.	HTML	Hypertext Markup Language

CHAPTER 1

INRODUCTION

The degradation of water resources has become a common problem. The conventional methods of monitoring involve the manual collection of water sample from different locations. These samples are tested in the laboratory using rigorous skills. Such approaches are time-consuming and are no longer to be considered to be efficient. Moreover, the current methodologies include analyzing various kinds of parameters of quality such as physical and chemical. The old method of quality detection and communication is time-consuming, low precision and costly. Therefore, there is a need for continuous monitoring of water quality parameters in real time. By focusing on the above issues, a low-cost monitoring system is using that can monitor air and water quality in real time using IoT. Each device has a unique identification and must be able to capture real-time data autonomously. Basic building blocks of IoT consist of sensors, processors, gateways, and applications. In the system, water quality parameters are measured by different sensors such as pH, turbidity, temperature for communicating data onto a platform via microcontroller-based system. Incorporating the Internet of Things (IoT) into water quality monitoring systems has revolutionized the field, offering remote, automated, and continuous monitoring capabilities. IoT-driven systems consist of interconnected sensors and devices placed in water sources, which collect and transmit data to centralized platforms for analysis. This data can then be accessed by water management professionals, regulatory agencies, and other stakeholders to make informed decisions and take timely action.

CHAPTER 2

LITERATURE SURVEY

The basic idea behind conducting a literature survey is to find out the current work being done in a chosen field. This includes the problem faced as well as the current progress on developing a complete solution for the said problem We got the basic idea to develop such a system because of the problem we faced and based on the drawbacks of a few existing systems. The papers that we have referred are as follows: In paper [1] illustrations of the relationship between pH, Total Dissolved Solids (TDS) and Conductivity Water Quality Parameters (WQPs) has been done.

It was stated that those parameters will be involved in the detection of hexavalent chromium contamination in the drinking water system. WQPs are obtained for four different hexavalent chromium contaminated samples experimentally using pH, TDS and conductivity sensors. With the use of different combination of estimated and measured values using several samples the estimation of WQPs computed. It was stated that the Multiple Linear Regression (MLR) mode3l is utilized to determine the correlation among the considered WQPs.

According to the results the errors between the actual and estimated the results can be finalized. It was found that the estimated values are closer to measured values and the estimated errors lie between 0.33% and 19.18%. Water quality prediction method based on LSTM Neural network [2] implemented a new water type prediction method based on Long and Short- Term Memory Neural Network (LSTM NN).

Finally the proposed method is compared with 2 different methods: one is based on back propagation neural network and the other is based on online sequential extreme learning machine.

The Cost effective Water Quality Evaluation System [3] proposed an Embodiment of low cost and immensely proficient water quality monitoring system. The system is a microcontroller based system with high degree of accuracy. It mainly determines several parameters of water such as temperature, turbidity, and potential of hydrogen (pH). This system makes possible to detect the sensor values and display it on LCD display. Design of Smart Sensors for Real-Time Water Quality Monitoring [4] proposed a microcontroller based real time system which notifies the user of the various parameters of water based on the various sensors used here. ZigBee receiver and transmitter modules are used for communication between the measuring and notification node.

The notification node presents the reading of the sensors and outputs an audio alert when water quality parameters reach unsafe levels. The results demonstrate that the system is capable of reading physiochemical parameters, and can successfully process, transmit and display the values obtained by the sensors. Water quality monitoring system based on GPRS is designed [5] system consists of monitoring stations subsystem, data communications subsystem and master station subsystem.

CHAPTER 3

METHODOLOGY

The economical and effective system of water quality observation is the toughest implementation of impure water. Drinking water could be terribly precious for all people as water utilities face more challenges. These challenges arise due to high population, less water resources etc. So, different methods are used to monitor in the real time water quality. To make sure that safe distribution of water is done, it should be monitored in real time for new approach in IOT based water quality has been projected. Real time water quality observation is monitored by data acquisition, method and transmission with increase in the wireless device network technology in internet of things. The measured values from the sensors are interfaced by microcontroller and the processed values remotely to the core controller ARM with a WI-FI protocol. This projected water quality observation interfaces sensors with quality observation with IOT setting. WQM selects parameters of water like temperature, pH level, water level and CO2 by multiple different device nodes. This methodology sends the information to the web server. The data updated at intervals within the server may be retrieved or accessed from anyplace within the world. If the sensors do not work or get into abnormal conditions then a buzzer will be ON.

3.1 EXISTING METHOD

Now a day's water is polluted due to many reasons. In this existing system the equipment cost is high and it takes a lot of time to process. Traditional methods have the disadvantages like complicated methodology, long waiting time for results low measurement precision and high cost. So, with the implementation in the technology, we use different methods and techniques to check quality of water. There is a disadvantage in the existing system that the system has high complexity and low performance.

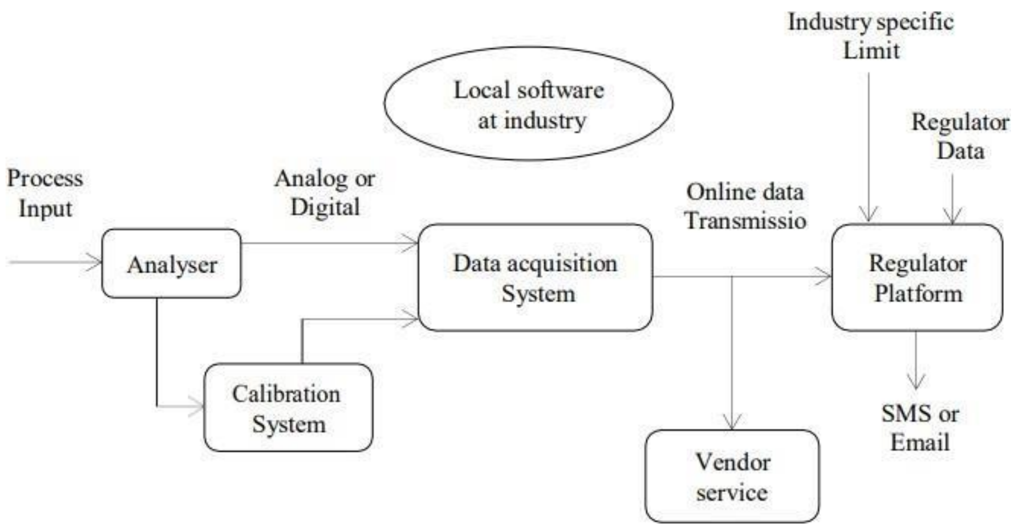


Fig. 3.1 Block Diagram of Existing Method

These are then put away in the information securing framework which is available in nearby programming of the business and are physically transmitted through online to the vendors and the administrative authorities such as the Local Contamination Control Board. From here further investigation is carried out. The online transmission will happen properly only if the internet connection is available.

3.2 PROPOSED METHOD

In this proposed system the complexity reduces and the performance increases by collecting the data of the water parameters such as temperature, pH, turbiditylevel. The data collected is updated in the web server which can be retrieved from anywhere in the world.

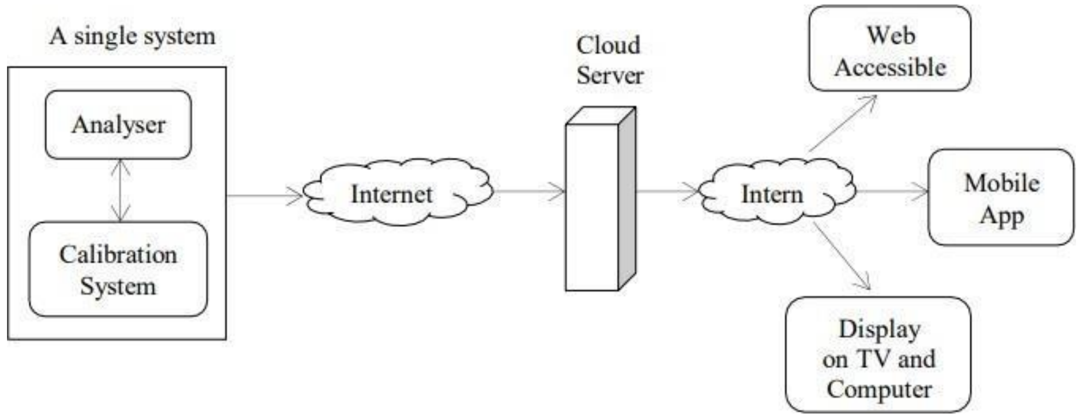


Fig. 3.2 Block Diagram of Proposed Method

The system has the analyzer and the calibration system inside a single framework with the goal that no human intercession is permitted and that all the gathered information is adjusted naturally. This information is promptly sent to the cloud through internet to get stored and they can be accessed by the vendors or the authority whenever they need. This information can be accessed to through web access, mobile app or can be shown on the television or the computer.

3.3 BLOCK DIAGRAM

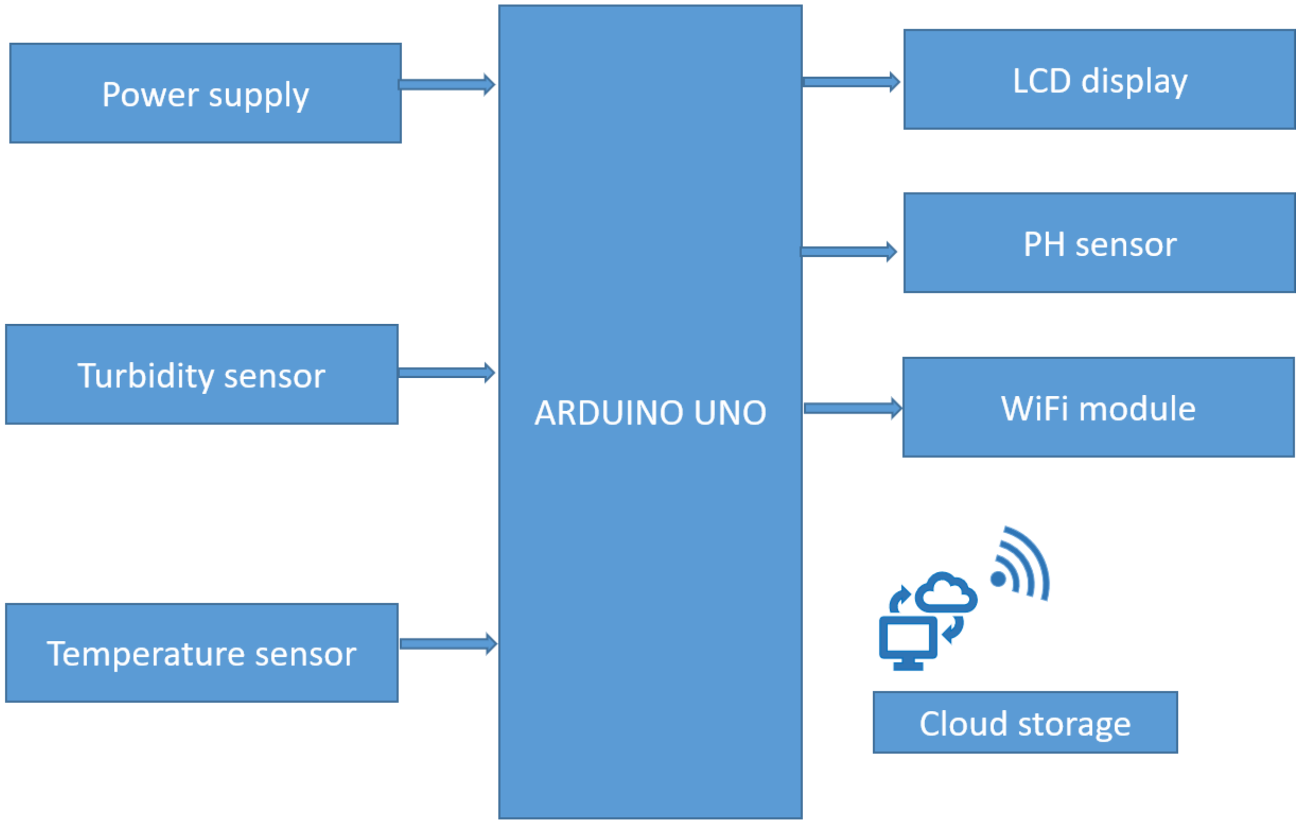


Fig. 3.3 Block Diagram

Hardware Specifications:

- Temperature Sensors
- pH Sensor
- Turbidity Sensor
- ARDUINO
- LCD Display

Software Specifications:

- Arduino IDE
- MC Programming Language: C

3.4 CIRCUIT DIAGRAM

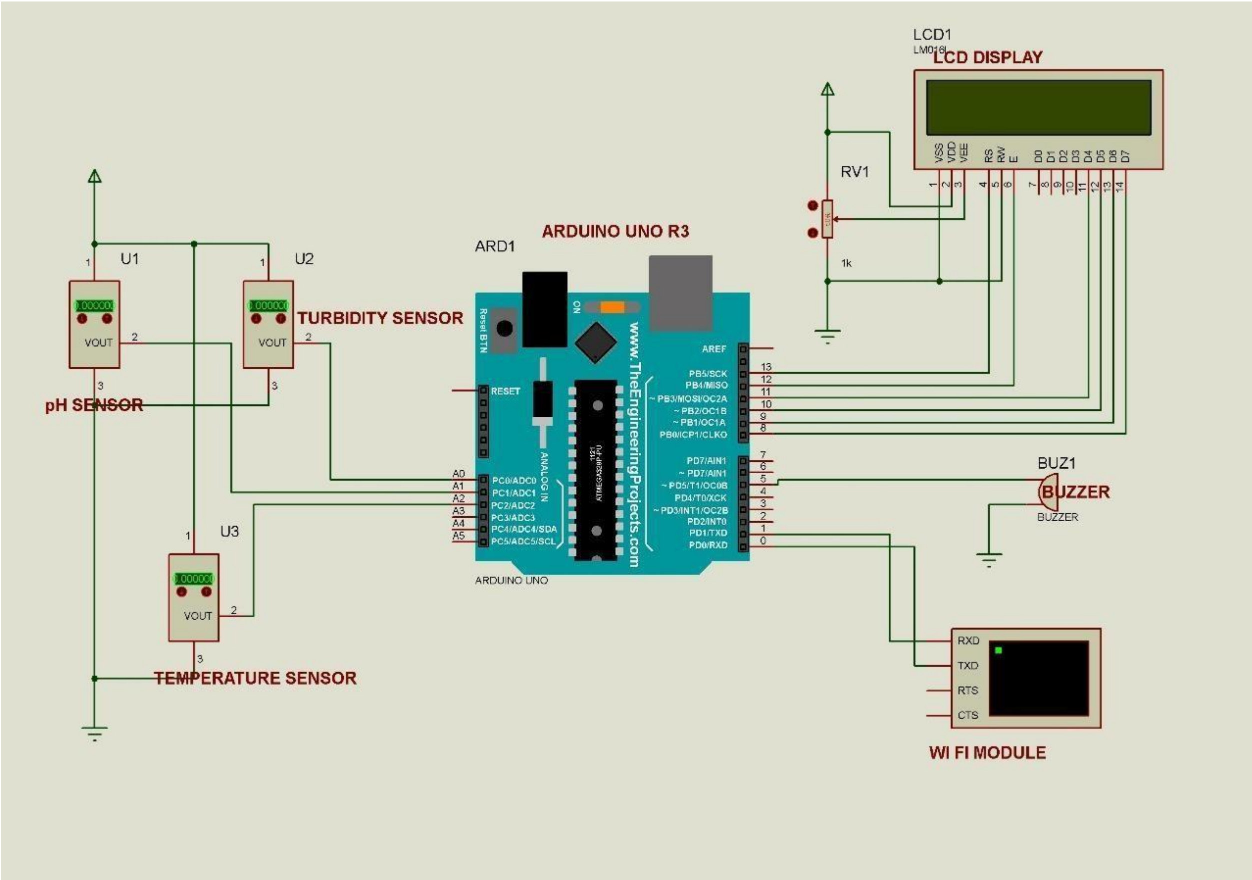


Fig. 3.4 Circuit Diagram

CHAPTER 4

COMPONENTS REQUIRED

4.1 ARDUINO UNO

Arduino is an open-source electronics platform based on easy-to-use hardware and software. Arduino boards are able to read inputs - light on a sensor, a finger on a button, or a Twitter message - and turn it into an output - activating a motor, turning on an LED, publishing something online. Message can be sent to the board what to do by sending a set of instructions to the microcontroller onthe board. To do so the Arduino programming language and the Arduino Software (IDE) are used.

Fig. 4.1 Arduino UNO

Over the years Arduino has been the brain of thousands of projects, from everyday objects to complex scientific instruments. Arduino was born at the Ivrea Interaction Design Institute as an easy tool for fast prototyping, aimed at students without a background in electronics and programming.

As soon as it reached a wider community, the Arduino board started changing toadapt to new needs and challenges, differentiating its offer from simple 8-bit boards to products for IOT applications, wearable, 3D printing, and embedded environments.

All Arduino boards are completely open-source, empowering users to build them independently and eventually adapt them to their particular needs. The software, too, is open- source, and it is growing through the contributions of users worldwide.

4.1.1 CONFIGURATION

- Microcontroller ATmega328
- Operating Voltage 5V
- Input Voltage(recommended) 7-12V
- Input Voltage(limits) 6-20V
- Digital I/O Pins 14(of which 6 provide PWM Output)
- Analog Input Pins 6
- DC Current per I/O Pin 40 mA
- DC Current for 3.3V pin 50 mA
- Flash Memory 32 KB(ATmega328) of which 0.5 KB used by boot loader
- SRAM 2 KB (ATmega328)
- EEPROM 1 KB (ATmega328)
- Clock Speed 16 MHZ

4.1.2 ATMEGA 328P – MICROCONTROLLER

ATMEGA328P is high performance, low power controller from Microchip. ATMEGA328P is an 8-bit microcontroller based on AVR RISC architecture. It is the most popular of all AVR controllers as it is used in ARDUINO boards.

Although we have many controllers ATMEGA328P is most popular of all because of its features and cost. ARDUINO boards are also developed on this controller because of its features. ATMEGA328 is used similar to any other controller. All there to do is programming Controller simply executes the program provided by us at any instant. Without programming controller simply stays put without doing anything.

As said, first we need to program the controller and that is done by writing the appropriate program file in the ATMEGA328P FLASH memory. After dumping this program code, the controller executes this code and provides appropriate response.

- With program memory of 32 Kbytes ATMEGA328P applications are many.
- With various POWER SAVING modes it can work on MOBILE EMBEDDEDSYSTEMS.
- With Watchdog timer to reset under error it can be used on systems with minimal human interference.
- With advanced RISC architecture, the controller executes programs quickly.
- Also with in chip temperature sensor the controller can be used at extreme temperatures.

4.2 DS18B20 1-WIRE TEMPERATURE SENSOR

DS18B20 is 1-Wire interface Temperature sensor manufactured by **Dallas Semiconductor Corp**. The unique 1-Wire Interface requires only one digital pin or two-way communication with a microcontroller.

The sensor comes usually in **two form factors**. One that comes in TO-92 package looks exactly like an ordinary transistor. Other one in a waterproof probe style which can be more useful when you need to measure something far away, underwater or under the ground.

Fig. 4.2 Types of DS18B20 Temperature Sensor

The DS18B20 communicates over a 1-Wire bus that by definition requires only one data line (and ground) for communication with Arduino. It has an operating temperature range of -55°C to +125°C and is accurate to ±0.5°C over the range of -10°C to +85°C. In addition, the DS18B20 can derive power directly from the data line (“parasite power”), eliminating the need for an external power supply.

Each DS18B20 has a unique 64-bit serial code, which allows multiple DS18B20s to function on the same 1-Wire bus. Thus, it is simple to use one microprocessor to control many DS18B20s distributed over a large area. Applications that can benefit from this feature include HVAC environmental controls, temperature monitoring systems inside buildings, equipment, or machinery, and process monitoring and control systems.

The resolution of the temperature sensor is user-configurable to 9, 10, 11, or 12 bits. However, the default resolution at power-up is 12-bit (i.e. 0.0625°C precision).

4.3 TURBIDITY SENSOR

Turbidity is the cloudiness or haziness of a fluid caused by large numbers of individual particles that are generally invisible to the naked eye, similar to smoke in the air. The measurement of turbidity is a key test of water quality.

Fig. 4.3 TURBIDITY SENSOR

Turbidity is caused by particles suspended or dissolved in water that scatter light making the water appear cloudy or murky. Particulate matter can include sediment, especially clay and silt, fine organic and inorganic matter, soluble colored organic compounds, algae, and other microscopic organisms.

4.3.1 IMPACT OF TURBIDITY

High turbidity can significantly reduce the aesthetic quality of lakes and streams. It can increase the cost of water treatment for drinking and food processing. It can harm fish and other aquatic life by reducing food supplies, degrading spawning beds, and affecting gill function.

4.3.2 TURBIDITY SOURCES

Sediment often tops the list of substances or pollutants causing turbidity. Natural sources can include erosion from upland, riparian, stream bank, and stream channel areas. Algae that grow with nourishment from nutrients entering the stream through leaf decomposition or other naturally occurring decomposition processes can also be a source of turbidity.

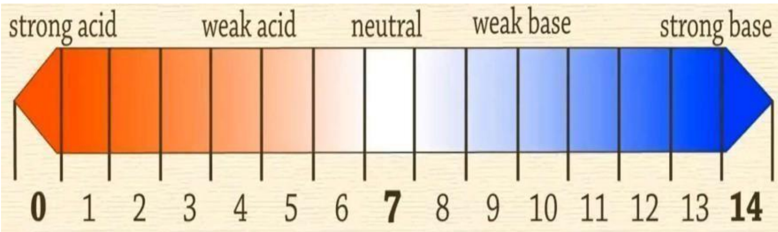
Stream channel movement can also release sediment. Organic matter from sewage discharges, especially during treatment plant bypasses, can contribute to turbidity. Human activities that disturb the land, such as construction, mining, and agriculture, can lead to high sediment levels entering water bodies during rainstorms due to stormwater runoff.

The unit of measurement is called a Nephelometric Turbidity Unit (NTU), which comes in several variations. The greater the scattering of light, the higher the turbidity. Low turbidity values indicate high water clarity; high values indicate low water clarity.

4.4 PH SENSOR

Ph is a scale used to specify how acidic or basic a water-based solution is. Acidic solutions have a lower Ph, while basic solutions have a higher Ph, Thus Ph sensor has the ability to determine the Ph of any solution, i.e it tells whether the substance is acidic, basic or neutral in nature. By knowing the Ph, we can monitor the water quality in Agricultural Farm and also in Fish Farming Similarly, Ph Sensor has a wide range of applications like waste water treatment, pharmaceuticals, chemicals & petrochemicals.

The term PH is a quantitative measure of the acidity or basicity of aqueous or other liquid solutions. The term, widely used in chemistry, biology, and agronomy, translates the values of the concentration of the hydrogen ion which ordinarily ranges between about 1 and 10−14 gram-equivalents per liter—into numbers between 0 and 14.



In pure water, which is neutral (neither acidic nor alkaline), the concentration of the hydrogen ion is 10−7 gram-equivalents per liter, which corresponds to a Ph of 7. A solution with a Ph less than 7 is considered acidic; a solution with a Ph greater than 7 is considered basic, or alkaline.

4.4.1 PH METER

A Ph meter is a scientific instrument that measures the hydrogen-ion activity in water-based solutions, indicating its acidity or alkalinity expressed as Ph. The Ph meter measures the difference in electrical potential between a Ph electrode and a reference electrode, and so the Ph meter is sometimes referred to as a “potentiometric Ph meter”. The difference in electrical potential relates to the acidity or Ph of the solution. The Ph Sensor has a rod-like structure usually made of glass, with a bulb containing the sensor at the bottom. The glass electrode for measuring the Ph has a glass bulb specifically designed to be selective to hydrogen-ion concentration. On immersion in the solution to be tested, hydrogen ions in the test solution exchange for other positively charged ions on the glass bulb, creating an electrochemical potential across the bulb. The electronic amplifier detects the difference in electrical potential between the two electrodes generated in the measurement and converts the potential difference to Ph units. The magnitude of the electrochemical potential across the glass bulb is linearly related to the Ph according to the Nernst equation.

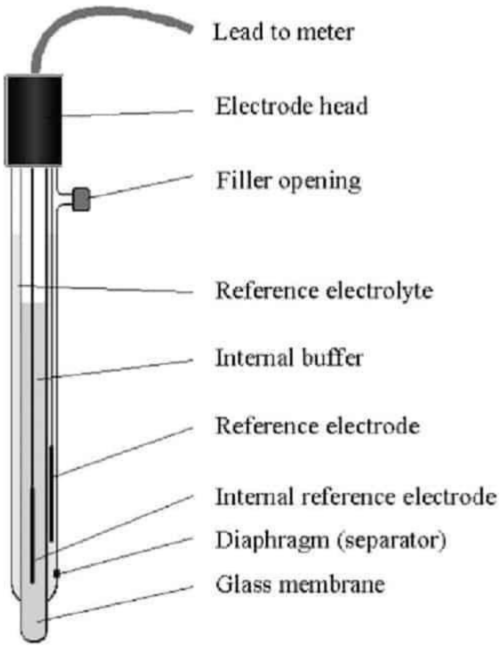


Fig. 4.4 PH SENSOR

The reference electrode is insensitive to the Ph of the solution, being composed of a metallic conductor, which connects to the display. This conductor is immersed in an electrolyte solution, typically potassium chloride, which comes into contact with the test solution through a porous ceramic membrane. The display consists of a voltmeter, which displays voltage in units of Ph.

4.5 LCD DISPLAY

There are many display devices used by the hobbyists. LCD displays are one of the most sophisticated display devices used by them. Once you learn how to interface it, it will be the easiest and very reliable output device used by you! More, for microcontroller based project, not every time any debugger can be used. So, LCD displays can be used to test the outputs.

4.5.1 PIN DIAGRAM

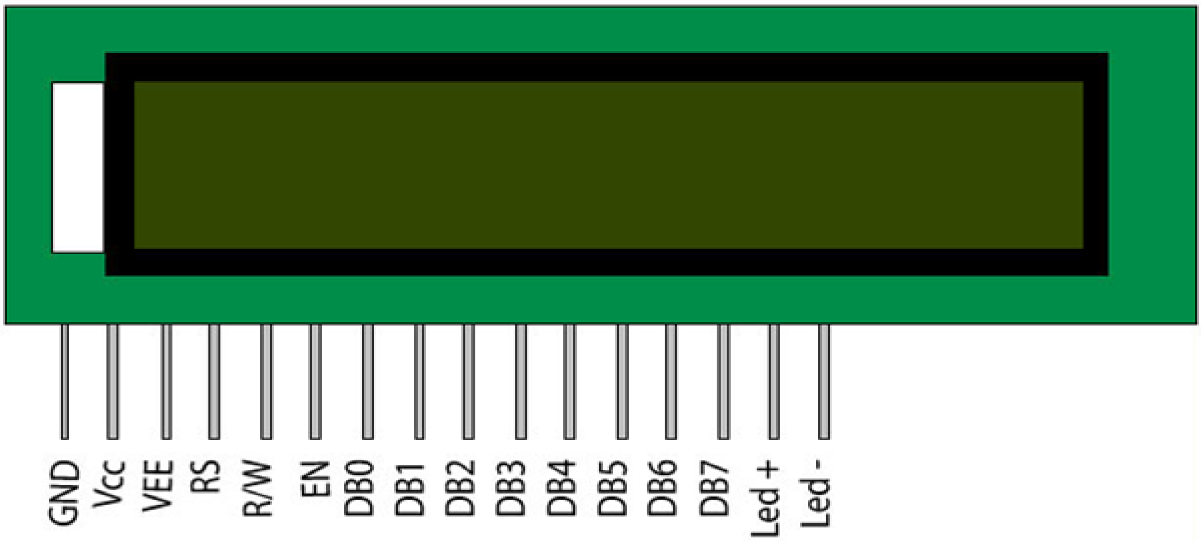


Fig. 4.5 LCD Pin Diagram

LCD accepts two types of signals, one is data, and another is control. These signals are recognized by the LCD module from status of the RS pin. Now data can be read also from the LCD display, by pulling the R/W pin high. As soon as the E pin is pulsed, LCD display reads data at the falling edge of the pulse and executes it, same for the case of transmission. LCD display takes a time of 39-43µS to place a character or execute a command. Except for clearing display and to seek cursor to home position it takes 1.53ms to 1.64ms. Any attempt to send any data before this interval may lead to failure to read data or execution of the current data in some devices. Some devices compensate the speed by storing the incoming data to some temporary registers.

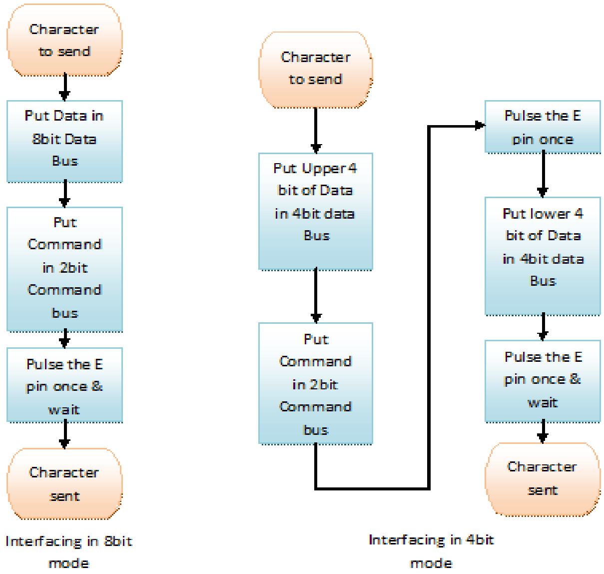


Fig. 4.6 Flow chart of interfacing LCD display

4.6 WIFI MODLE

The ESP8266 is a very user friendly and low cost device to provide internet connectivity to your projects. The module can work both as a Access point (can create hotspot) and as a station (can connect to Wi-Fi), hence it can easily fetch data and upload it to the internet making Internet of Things as easy as possible. It can also fetch data from internet using API's hence your project could access any information that is available in the internet, thus making it smarter. Another exciting feature of this module is that it can be programmed using the Arduino IDE which makes it a lot more user friendly.

However, this version of the module has only 2 GPIO pins (you can hack it to use upto 4) so you have to use it along with another microcontroller like Arduino else you can look onto the more standalone ESP-12 or ESP-32 versions. So if you are looking for a moduleto get started with IOT or to provide internet connectivity to your project then this module is the right choice.

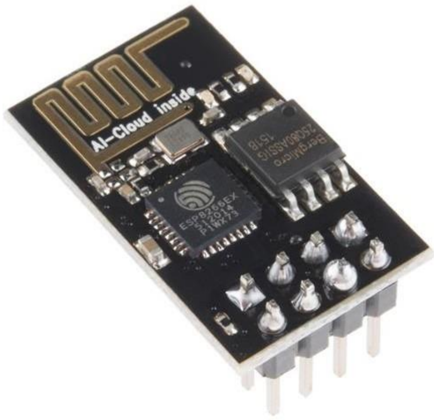


Fig. 4.7 Wi-fi module

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, meaning, you can simply hook this up to your Arduino device and get about as much Wi-Fi-ability as a Wi-Fi Shield offers (and that's just out of the box). The ESP8266 module is an extremely cost-effective board with a huge, and ever growing, community.

This module has a powerful enough on-board processing and storage capability that allows it to be integrated with the sensors and other application specific devices through its GPIOs with minimal development up-front and minimal loading during runtime. Its high degree of on-chip integration allows for minimal external circuitry, including the front-end module, is designed to occupy minimal PCB area.

The ESP8266 supports APSD for VoIP applications and Bluetooth co-existence interfaces; it contains a self-calibrated RF allowing it to work under all operating conditions, and requires no external RF parts.

4.6.1 FEATURES

- Low cost, compact and powerful Wi-Fi Module
- Power Supply: +3.3V only
- Current Consumption: 100mA
- I/O Voltage: 3.6V (max)
- I/O source current: 12mA (max)
- Built-in low power 32-bit MCU @ 80MHz
- 512kB Flash Memory
- Can be used as Station or Access Point or both combined
- Supports Deep sleep (<10uA)
- Supports serial communication hence compatible with many development platform like Arduino
- Can be programmed using Arduino IDE or AT-commands or Lua Script

4.6.2 APPLICATIONS

- IOT Projects
- Access Point Portals
- Wireless Data logging
- Smart Home Automation
- Learn basics of networking
- Portable Electronics
- Smart bulbs and Sockets

4.7 SOFTWARE REQUIRED

4.7.1 ARDUINO IDE

The Integrated Development Environment (IDE)is a combination of editor, linker and a compiler which helps the developer to make their Firmware for their Innovative Projects. Arduino IDE play a major role in open source platform for fast prototyping and easy to access of library. It is user friendly tool for beginners and it supports programming language like embedded C, Luna etc. Over the years Arduino has been the brain of thousands of projects, from everyday objects to complex scientific instruments. Its supports all the variant of Arduino boards like Arduino Uno, Nano and Mega etc. As soon as it reaches a wider community, the Arduino board started changing to adapt to new needs and challenges, differentiating its offer from simple 8-bit boards to products for IoT applications, wearable devices, 3D printing, and embedded environments. With this Arduino Integrated Development Environment, one can edit, compile and upload Arduino sketches to the Arduino boards.

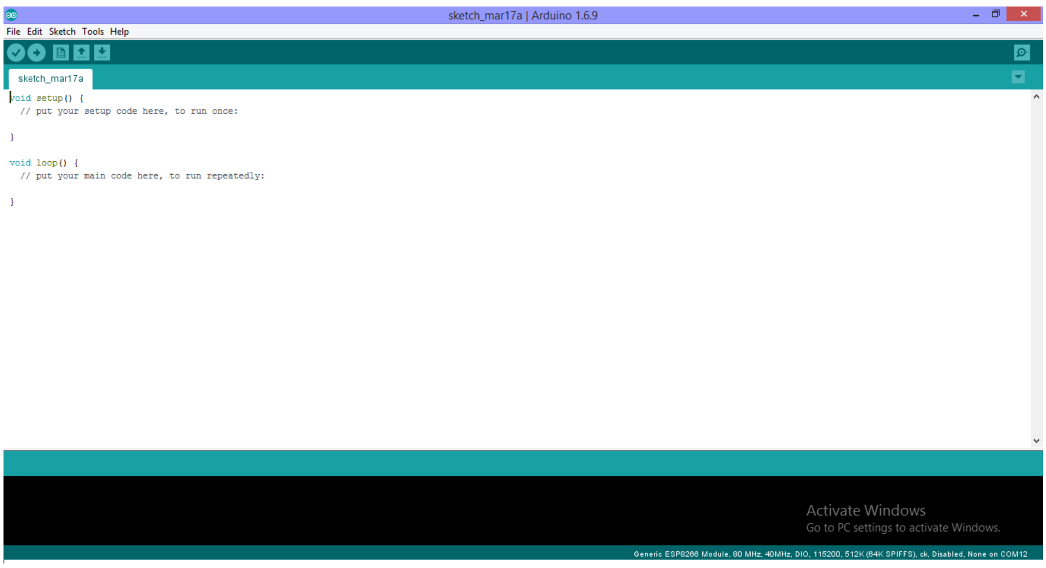


Fig. 4.8 Arduino IDE software

4.7.2 THINGSPEAK IOT SERVER

- Thing Speak is an open data platform for the Internet of Things. Your device or application can communicate with Thing Speak using a RESTful API, and you can either keep your data private, or make it public. In addition, use Thing Speak to analyze and act on your data. Thing Speak provides an online text editor to perform data analysis and visualization using MATLAB®. You can also perform actions such as running regularly scheduled MATLAB code or sending a tweet when your data passes a defined threshold. Thing Speak is used for diverse applications ranging fromweather data collection and analysis, to synchronizing the colour of lights across the world.
- At the heart of Thing Speak is a time-series database. Thing Speak provides users with free time-series data storage in channels. Each channel can include up to eight data fields. This tutorial provides an introduction to some of the applications of Thing Speak, a conceptual overview of how Thing Speak stores time-series data, and how MATLAB analysis is incorporated in Thing Speak.

4.7.3 CONNECT ESP8266 TO THING SPEAK

When makers and hobbyists think of Internet of Things (IoT), two things come to their mind: one is ESP8266 and the other is ThingSpeak. One is the Hardware part of the IoT System whereas the other provides the necessary API (or the user interface) for the system. In this project, I'll show you how to Connect ESP8266 to ThingSpeak Application and how the ESP8266 ThingSpeak collaboration works.

Table of Contents

- Overview
- Creating ThingSpeak Account
- Prerequisites for the Project
- Circuit Diagram for ESP8266 ThingSpeak Interface through AT Commands
- Components Required
- Connect ESP8266 to ThingSpeak using AT Commands
- Circuit Diagram for ESP8266 ThingSpeak Interface using Arduino
- Connect ESP8266 to ThingSpeak using Arduino
- Code
- Conclusion & Applications

Overview

We have already seen one such IoT implementation using ESP8266 and a REST Platform. What makes ThingSpeak different and special is that is uses simple HTTP Protocol to transfer, store and retrieve information from different sensors.

Also, the ThingSpeak Application allows us to log the sensor data, track locations and even social networking of things.

Another important thing (or rather a unique feature) about ThingSpeak is its support fromMATLAB. The close relationship between ThingSpeak and MATLAB has lead to integrate several key features of MATLAB into the ThingSpeak Application.

One such feature is to analyze and visualize the user data i.e. the sensor data in a graphicalway without the MATLAB License.

Keeping the corporate stuff aside, the ThingSpeak Application is a great tool for our IoT related projects and hence this project focuses on the basics i.e. how to connect ESP8266to ThingSpeak Application and also how the ESP8266 ThingSpeak Interface can be usedin our projects.

4.7.4 CREATING THINGSPEAK ACCOUNT

The first thing you need to do is to create an account with ThingSpeak. Since the collaboration with MATLAB, you can use your MathWorks credentials to login to ThingSpeak using the Sign In link from this page: **THINGSPEAK**

If you do not have one, you need to create an account with MathWorks and login to ThingSpeak Application.

NOTE: The MathWorks Account can be used for both MATLAB as well as ThingSpeak logins.

After logging in, you need to create a new channel for the data to be stored. For this go toChannels–>My Channels and click on New Channel.

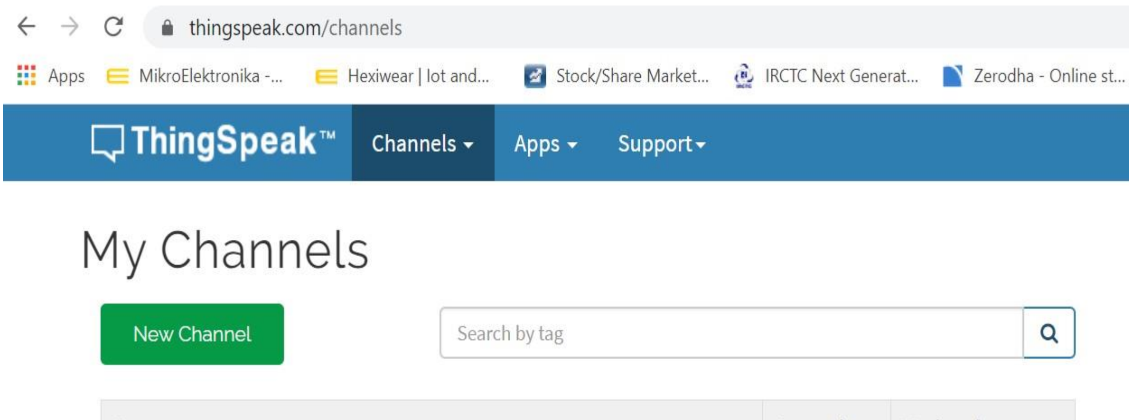


Fig. 4.9. Thingspeak intro and channel creation

Enter the name of the channel and name of Field 1 in the corresponding sections. Fields ina channel are used to hold the data and each channel can have up to 8 fields. After entering the details save the channel. In my case, I've created a Channel called "Test Channel" and the Field 1 as "Random Number". You will see why in the later sections There are a few other things you need to do in the ThingSpeak Application, but I'll tell about it when you need it. The next step is to prepare the hardware for the project, which includes ESP8266 WiFi Module, Arduino UNO Board and a few connecting wires.

4.7.5 PREREQUISITES FOR THE PROJECT

I'll show you two ways of how to connect ESP8266 to ThingSpeak Application. For boththe ways, you need to make sure that your ESP8266 Module is loaded or flashed with ATCommands Firmware. For more information on this, I suggest you to go through the procedure mentioned in the project **How To Update Flash Esp8266 Firmware**.

NOTE:

- For flashing the AT Commands firmware, you need to enable the programming mode in ESP8266 by connecting GPIO0 to GND and resetting the module.
- But in this circuit (assuming you have already flashed the firmware), the ESP Module is in Normal Mode i.e. GPIO0 can be left floating.

After flashing your ESP with AT Commands Firmware, you can now proceed with connecting ESP8266 to ThingSpeak. As I said before, you can do this in two ways: One is through AT Commands and the other way is through Arduino (even this way uses AT Commands but Arduino controls them. I'll show you both ways to connect ESP8266 to ThingSpeak. The circuit diagram in order to connect ESP8266 to ThingSpeak is very simple. In fact, you might have already seen this connection before. The Arduino UNO Board is used just to transmit the data between the computer and the ESP8266 i.e. it acts as an USB-to-UART Converter.

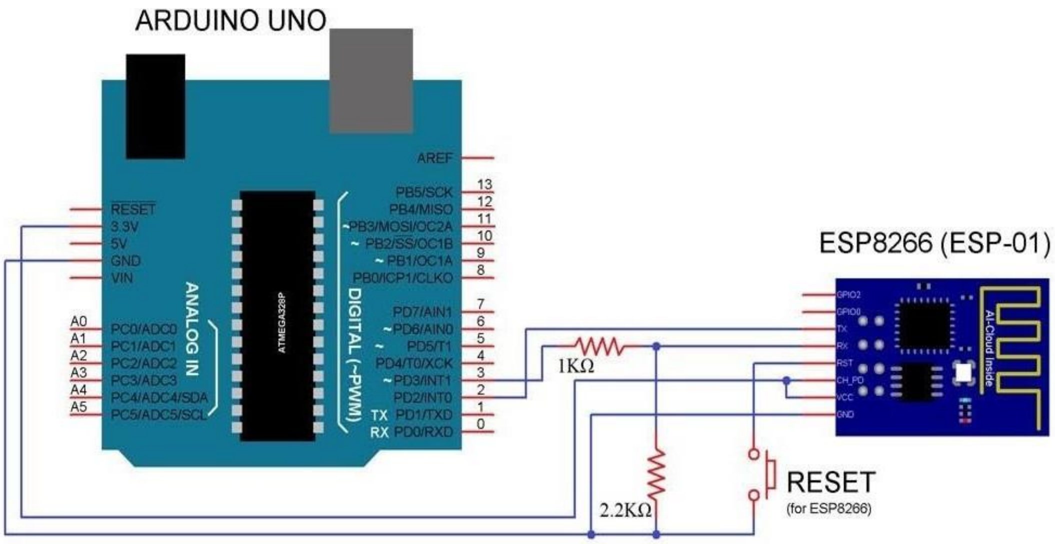


Fig. 4.10 ESP8266 THINGSPEAK INTERFACE

Components Required

- Any Arduino Board or USB-to-UART Converter
- ESP8266 WiFi Module (ESP-01)

4.7.6 CONNECT ESP8266 TO THINGSPEAK USING AT COMMANDS

Connect the Arduino board to the computer and open the serial monitor of Arduino andcheck for connectivity using the following command.

```
AT
```

Note that I have set the baud rate to 115200 and also selected “Both NL & CR” option inthe Serial Monitor. After you get a response as “OK”, you can proceed with connecting your ESP Module to your Wi-Fi Network using the following command.

```
AT+CWJAP=”SSID”,”PASSWORD”
```

Replace SSID with the name of your WiFi Network and enter the password in place of PASSWORD. You will now get a confirmation response regarding WiFi Connection as follows.

WIFI CONNECTED

WIFI GOT IP

OK

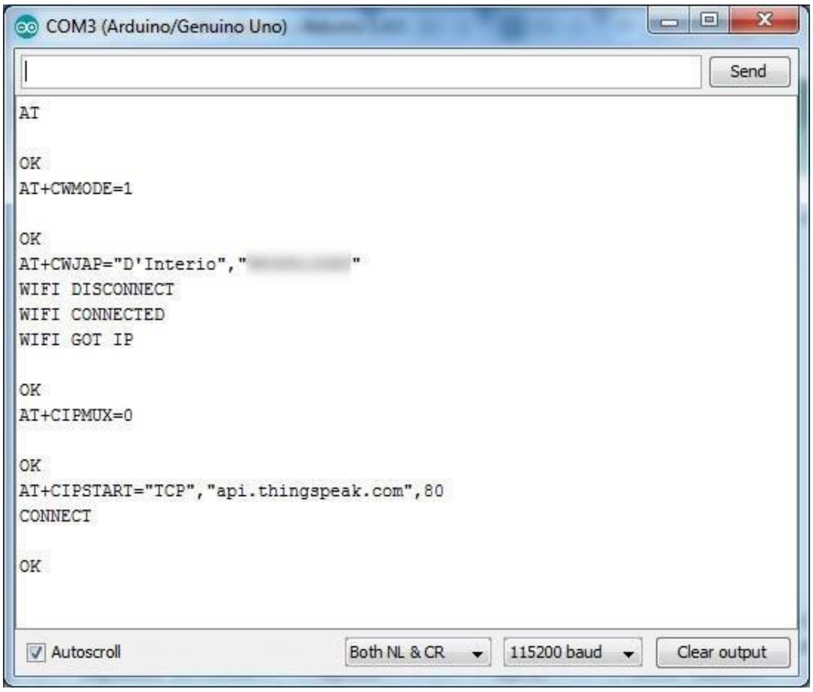


Fig. 4.11 AT Commands of WIFI module testing

Now, you need to set single connection using the following command.

AT+CIPMUX=0

Next step is to connect to the ThingSpeak API using TCP Protocol. For this, you need touse the following command.

AT+CIPSTART=”TCP”,”api.thingspeak.com”,80

Alternatively, you can use the IP Address of the host api.thingspeak.com i.e. 184.106.153.149.

```
AT+CIPSTART=”TCP”,”184.106.153.149”,80
```

NOTE:

- After starting the TCP connection, if you don’t perform any action, the connection will be closed automatically after some time, usually after 1 minute.

Now, you have successfully enabled the “TCP” connection between the ESP8266 and ThingSpeak. Next, you can send any data through this TCP Connection. For this, use the following commands one after the other.

```
AT+CIPSEND=51
GET /update?api_key=XXXXXXXXXXXXXXXX&field1=255

AT+CIPCLOSE
```

Once the TCP connection is established, you can send data using certain commands. This part can be a little tricky but trying it for a couple of times, you will understand the process. In order to send the data, you need send three different information: One is the actual send command, next is the data along with the ThingSpeak Field Key and finally the close connection command. I’ll try to explain these steps in a detailed way as possible.

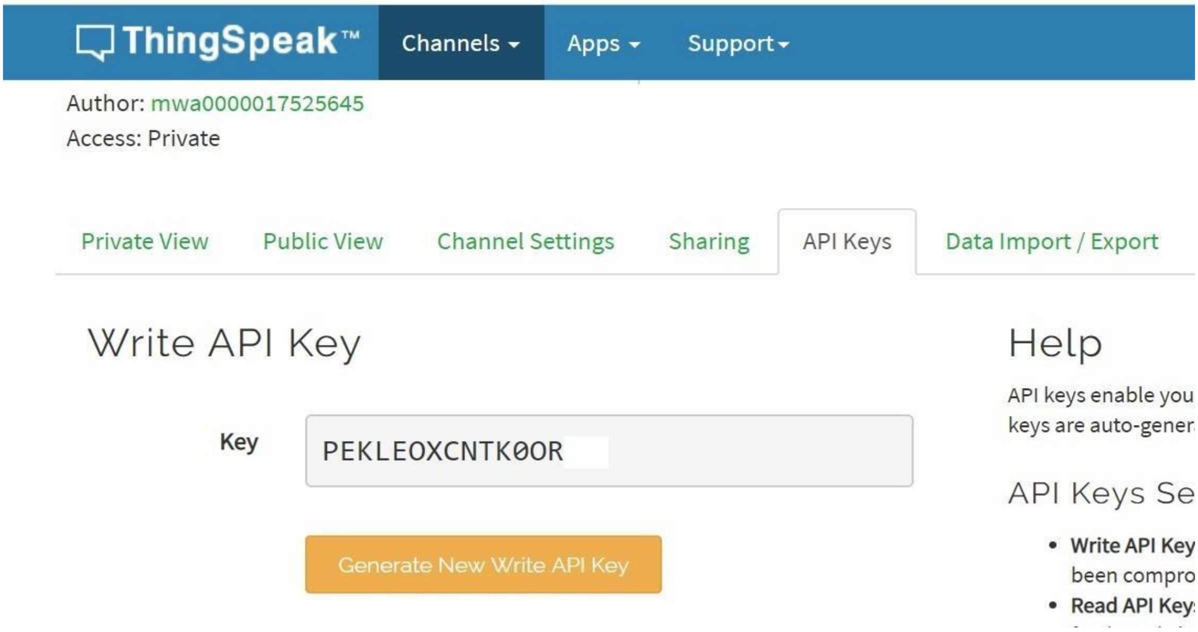


Fig. 4.12 Thingspeak Write API key

Before sending the data, you need to acquire the API Key. For this, go to you channel (theone you have just created) and click on "API Keys" Tab. Below that, you can find Write API Key, which is an alphanumeric string of 16 characters. Make a note of this key. Now,use the following command to initialize the data transmission.

AT+CIPSEND=51

The value 51 is the length of the data to be transmitted. This includes the complete data including the API Key and the "\r" and "\n" values. For this command, you will get the following response.

OK

Now type the following information and hit send. Here, "XXXXXXXXXXXXXXXX" isnothing but the 16 character Write API Key, which you have just copied. And the number"143" is the actual data you are transmitting to field1.

```
GET /update?api_key=XXXXXXXXXXXXXXXX&field1=143
```

After typing this text and hitting on send, you will not get any response. It is actually waiting for the close command. Once you hit send for the above text, immediately type the following command and hit send.

```
AT+CIPCLOSE
```

The moment you hit send, you will get the following response (not the exact one, butsomething similar).

```
Recv 51 bytes
SEND OK

+IPD,1:5CLOSED
```

Here, the number 5 means, it is my 5TH message to that Key. Now, Open the Thing SpeakAPI and open your channel. In the "Private View" tab, you can see the value '143' in the Field 1 Chart.

That's it. If you understood and followed all these steps, then you might have successfully connected ESP8266 to ThingSpeak API. To send more data, repeat the steps from creating the TCP Connection.

4.7.7 APPLICATIONS AND ADVANTAGES

APPLICATIONS:

- **Drinking Water Monitoring:** IoT devices can monitor the quality of water from its source to the tap, checking for contaminants such as bacteria, heavy metals, and chemicals. This helps ensure safe drinking water.
- **Industrial Water Quality:** Industries use water in various processes and need to monitor its quality to meet regulatory standards and protect equipment from damage due to contaminants.
- **Agricultural Water Management:** Farmers can monitor water quality used for irrigation, ensuring it is suitable for crops and does not contain harmful contaminants.

ADVANTAGES:

- **Real-Time Monitoring:** IoT systems provide continuous, real-time data on water quality, enabling prompt action if contamination is detected.
- **Improved Accuracy:** Automated monitoring reduces the chances of human error and provides consistent, precise measurements.
- **Data Analysis and Insights:** IoT systems can generate large amounts of data that can be analyzed for trends, helping improve water management and quality over time.

CHAPTER 5

RESULTS AND DISCUSSIONS

Three parameters namely pH, turbidity, temperature are measured using the experimental setup. The setup is connected to the cloud platform to analyze the data in graphical format.

The final integration and the obtained results are shown through various images andvalues collected during the testing of the system.

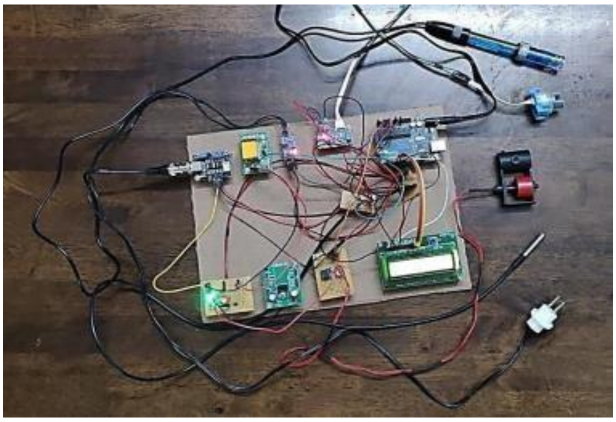


Fig. 5.1 Interfacing all the sensors with Arduino UNO

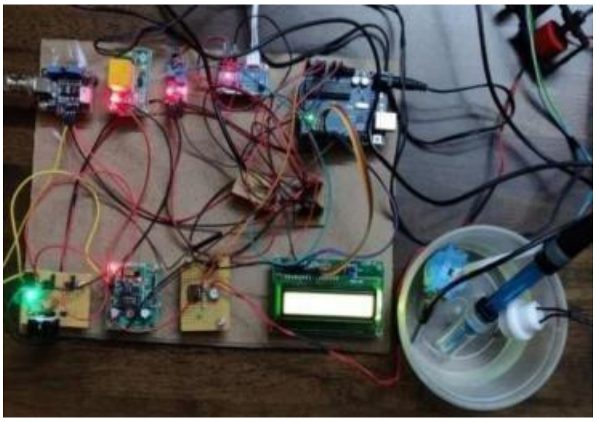


Fig. 5.2 Sensor framework has been turned on

PARAMETERS	QUALITY RANGE	UNITS
Turbidity	5-10	NTU
pH	6.5-8.5	pH
Temperature	27-29	Celsius

Table 5.1 Parameters of water

It shows the safe and acceptable range of the turbidity sensor, pH sensor, and temperature sensor according to the WHO standards.

Fig. 5.3 LCD displaying the project title

Fig. 5.4 LCD displaying the values of various components

WATER TYPE	**TEMPERATURE**	**pH**	**TRBIDITY**
Drinking Water	26 degree	6.36	629
Salt Water	26 degree	6.39	520
Mud Water	25 degree	5.06	390

Table 5.2 List of water samples and its parameters

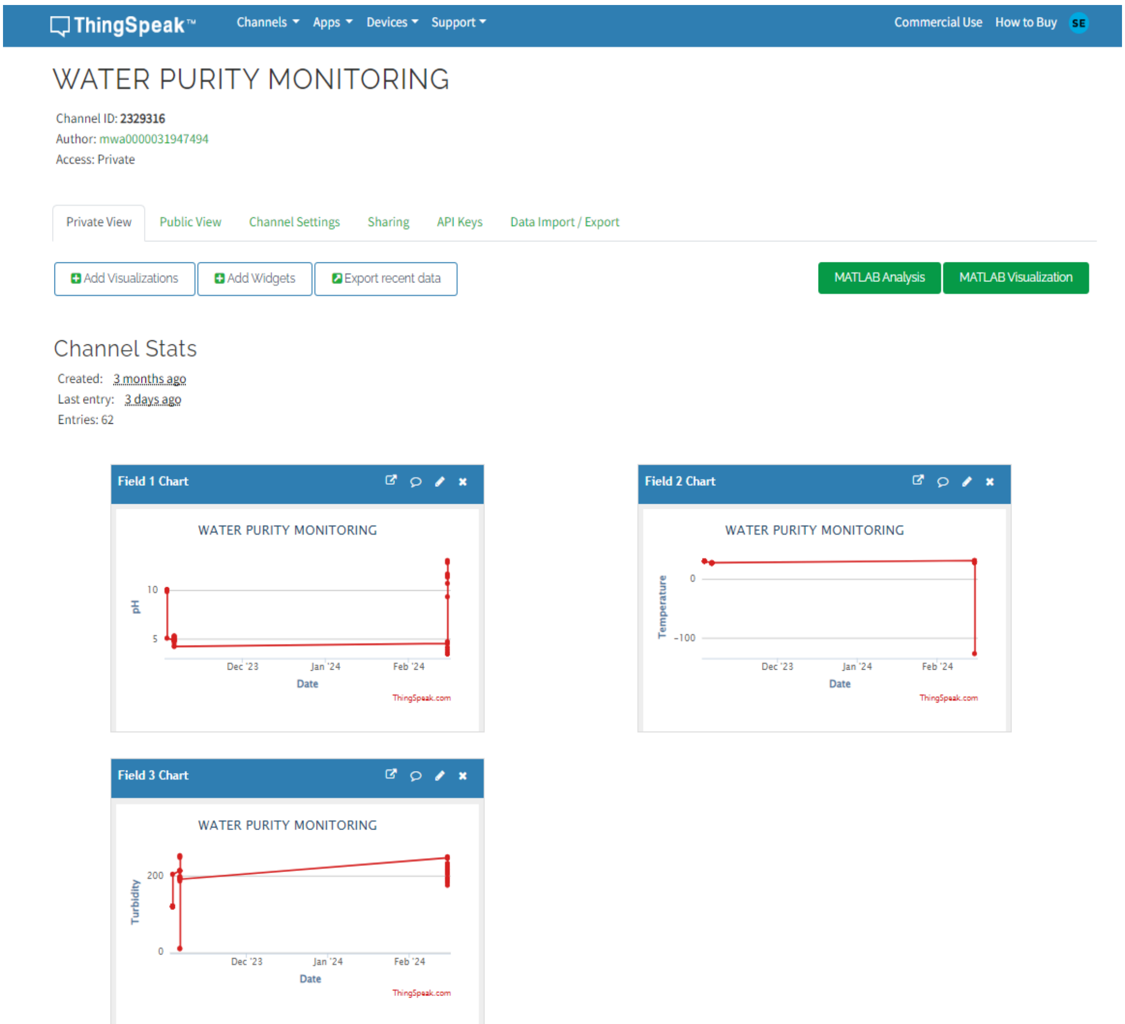


Fig. 5.5 Final output of Thingspeak server

CHAPTER 6

CONCLUSION

An Internet of Things (IoT) system collects copious amounts of data and continuously evaluates the quality of the water to enable continuous monitoring of water contamination in remote places. This technology performs two functions: it searches the water ecosystem thoroughly and quickly finds instances of pollution or natural disasters. It provides decision- makers with visual representations of the water conditions and uses a high-speed network to transmit data about anomalous water quality to monitoring centers. Additionally, by using an autonomous pump, this method maximizes independence and reduces water consumption. The system to monitor the water of environment using Arduino microcontroller, IOT Technology is proposed to improve quality of water. With the use of IOT technology enhances the process of monitoring various aspects of environment such as water quality monitoring issue proposed in this project. Here, using the pH sensor, turbidity sensor and conductivity sensor gives the sense of different type of measurements and Arduino is the heart of this project, Which control the entire process.

FUTURE SCOPE

The future extension of the present work is immense. There is scope for improvement in this project based on the advancement in technology. The future extent of this project is to check the natural conditions, drinking water quality, treatment and sterilization of waste water and so forth. This framework could likewise be actualized in different mechanical procedures. The framework can be adjusted by the requirements of the client and can be actualized alongside labview to screen information on PCs. Identifying the more parameters for most secure reason and increment the parameters by expansion of different sensors. By interfacing transfer we can control the stockpile of water. In future, it very well may be executed to screen the nature of water in family unit as well as for the entire city or a town or a dam, from where the water supply happens with blend of different sensors, crossover quality checking frameworks can be structured sooner rather than later for the entire city or town. In the future, we plan to implement biological parameter of the water and install the system in several location of pond and also in water distribution network to collect water quality data and send to water board. All these ideas can be implemented in the future to enhance the working of project.