PROJECT REPORT ON:

"SMART WATER QUALITY MONITORING SYSTEM "

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UNDERTAKING

I declare that the work presented in this project titled "**Smart Water Quality Monitoring System using ARDUINO** ", submitted to the All India council of robotics and Automation, for the award of the Internship in **INTERNET OF THINGS**, is my original work. I have not plagiarized or submitted the same work for the award of any other Internship. In case this undertaking is found incorrect, I accept that my Project may be unconditionally withdrawn.

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ASHA (3GN18EC009)

CERTIFICATE

Certified that the work contained in the project titled "**Smart Water Quality Monitoring System using ARDUINO**", by **P.GOWRI** and **ASHA** has been carried out under my supervision and that this work has not been submitted elsewhere for an Internship.

All India Council of Robotics and Automation
Name of the Internship
Delhi - 110020

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I take upon this opportunity to acknowledge the many people whose prayers and support meant a lot to me

I am deeply indebted to my mentor **SUMIT CHATTERJEE RESEARCH ENGINEER**, **ALAAUDEEN K M** who motivated me along the way

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ABBREVATIONS

- **IOT : Internet Of Things**
- **WQMS : Water Quality Monitoring System**
- **WSN : Wireless Sensor Network**
- **p H : Potential Of Hydrogen**
- **OPR : Oxidation Potential Reduction**
- **Turb : Turbidity**
- **WQI : Water Quality Index**

INTRODUCTION TO IOT

An IOT is a system of interrelated communicating devices that are provided with unique identifiers and the ability to transfer data over the network without requiring human to human or human to computer relation. In other words IOT can be defined as creating a real time situation without interference of humans. Or simply IOT means the connection that takes all the physical places and things in the world and connecting them to the internet. In IOT all the things that are connected to the internet can be put into three categories:

i. Things that collect the information and then send it.
ii. Things that receive information and then act on it.
iii. Things that do both the processes as above.

The most used communication channels to communicate objects to internet in IOT are **Wi-Fi, Bluetooth, Zigbee Wireless, NFC, Wi-Fi direct etc.**

Tracking behavior for real time marketing, Enhanced situational awareness, Process optimization, Optimised resource consumption, Instantaneous control and response in complex systems are some of the benefits of IOT.

IOT is considered one of the fast developing and vast area of study. Real time analysis and data security are some of the essential features of IOT.

Main application areas for IOT are:

- Home automation
- Smart cities
- Smart manufacturing
- Wearables
- Healthcare
- Automobiles
- Transportation

PROJECT DESCRIPTION :

PROJECT TITLE : IOT BASED SMART WATER QUALITY MONITORING SYSTEM USING ARDUINO AND NODEMCU

Abstract :

Fresh water is becoming a issue of concern now. Safe drinking water has become scarce due to combined effects of climatic changes and increased population. Thus the water quality monitoring and treating water has become an immediate challenge to be taken especially for domestic water. Manual approach were costly, time consuming and also lack real time feedback. Recently developed systems utilizing Wireless Sensor Network (WSN) technology have reported weaknesses in data security, energy management and communication coverage.
Due to recent advances in IOT has led to development of the system which is cost effective, secure, more efficient and also have real time capabilities used for domestic applications.

INTRODUCTION

Water is essential for life on earth. Most of the part of earth's surface is water yet numerous countriesare facing shortage of water. Contaminated water is harmful to humans and can even degrade plants and aquatic lives. This project aims for proper analyzing of the water quality and then acting according to the requirements and make the water suitable for domestic uses.

There are many parameters of checking the quality of water. Some of the parameters are turbidity, temperature, potential of hydrogen, chlorine content and many more. WHO/USEPA are continuously working on developing guidelines and standards related to water quality. The list of WQMS parameters is large, thus a limited set of parameters are generally utilized to monitor water quality. On the basis of such parameters a Water Quality Index (WQI) generates a single number expressing the quality of water acquired from the target locality at a specific time.

The main objective of WQI is to transform complicated water quality data into some understandable form of information and this is done by the use of IOT by creating IOT platform to show the result.

By execution of this project we can check the quality of water and then manage to know the required action to be taken and at last provide fresh water for domestic use. The real time analysis of the output helps out the to provide required output.

LITERATURE SURVEY :

Maintaining water quality has become a major area of concern, thus many countries use different techniques to check water quality and then treat them as per the requirement. Some of the previously used techniques are listed below.

1. Traditional water quality monitoring :

   Most of the countries still use traditional mechanisms to check the quality of water. The process is done through following steps.

   i. First manually collecting the sample.
   ii. Then sending them for laboratories for testing.
   iii. Performing analysis and checking for contamination and microbes
   iv. Finally water quality is determined using PQI.

   The drawbacks of such a techniques are that they are time consuming, costly and lack real time analysis.

2. Enhanced Traditional Water Quality Monitoring :

   With advances in sensors technology, traditional water quality measuring techniques were slightly improved. In such type the quality check is done using different sensors like temperature sensors, pH sensors, turbidity sensors in this project. Though this technique was an improvement from the traditional method but it couldn't provide the real time analysis.

3. WSN-Based Water Quality Monitoring :

   With further advances in portable sensors, communication and computing technologies, here the technique used was WSN technology. In this first an embedded microcontroller reads the specific water parameters using sensors and then processes the data and then transfers data to main server and then the after the required actions are implemented.

4. WSN and Machine Learning (ML) Techniques Based Water Quality Monitoring :

   Though WSN greatly resolved some drawbacks of previous systems, these systems had some limitations i.e., high energy requirements, less data security, low communication speed etc. limitations, e.g., high energy requirements, compromised security, low communication speed, storage issues, high installation/maintenance costs, etc. In this the researchers used the ML techniques to access data which also predicts the output. This technique enhanced efficiency of the WSN systems but the major drawback here was cost.

5. Smart Water Quality Monitoring :

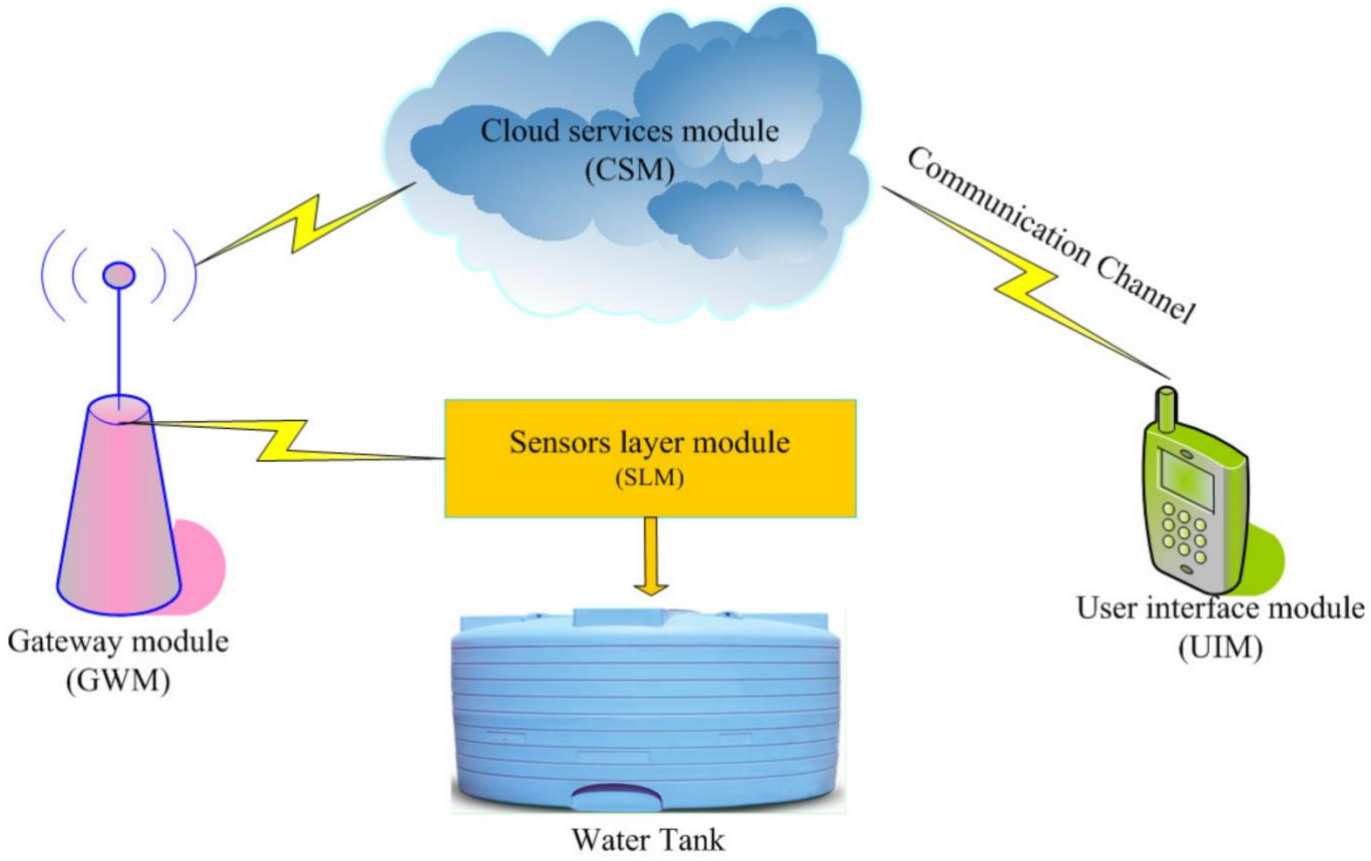
All the drawbacks or the problems faced above were solved in this technique i.e., by the application of IOT . By this concept of IOT water can be monitored in real time from any location of the world by the use of internet. Then the output is uploaded on to the cloud by using WSN and then the understandable result is provided to the user.

The advantage of using this technique is that these systems provide cost effective systems,these provide real time analysis for the variables.

A Typical IoT-WQMS Model

A typical IOT-WQMS comprises four basic modules :

- Sensors layer module (SLM)
- Gateway module (GWM)
- Cloud services module (CSM)
- User interface module (UIM)



A Typical Water Quality Monitoring System

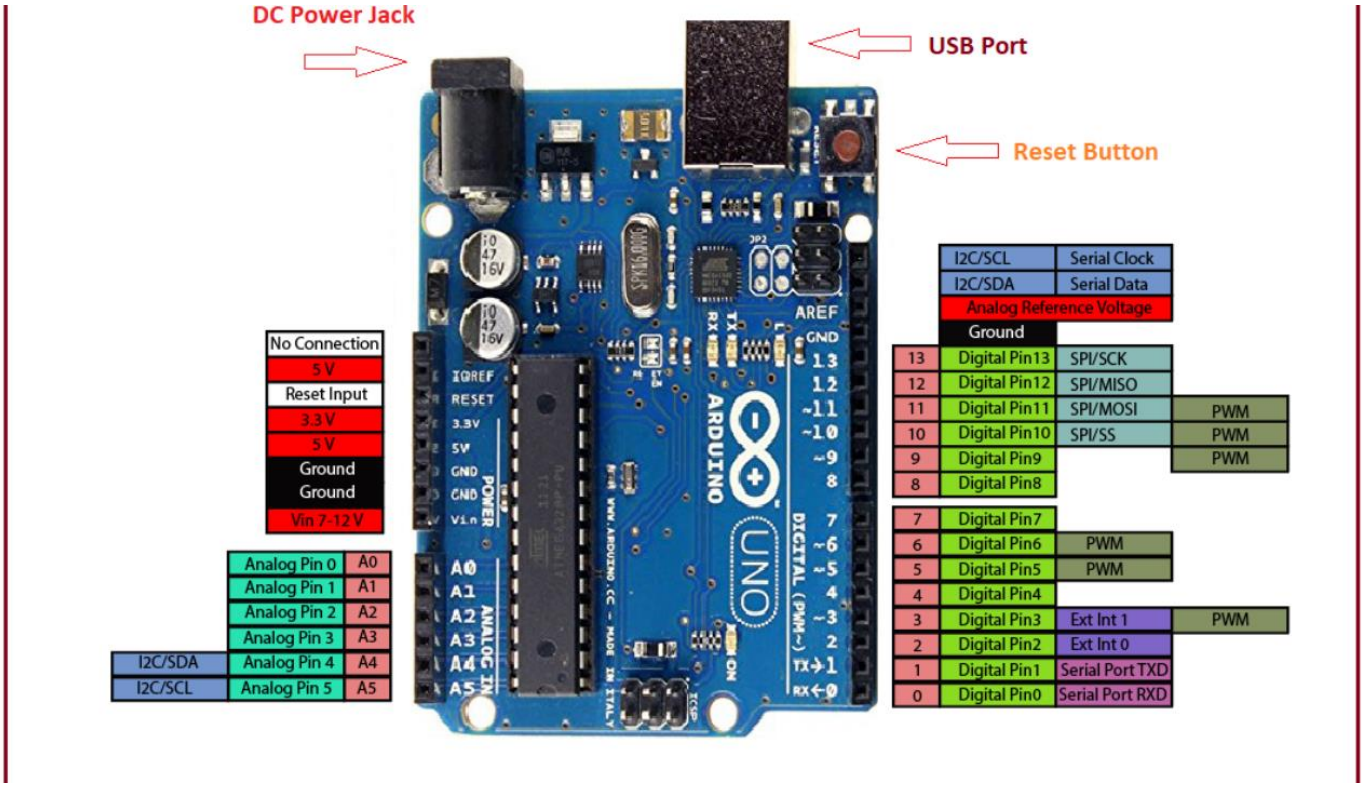
HARDWARE COMPONENTS:

1. ARDUINO UNO :

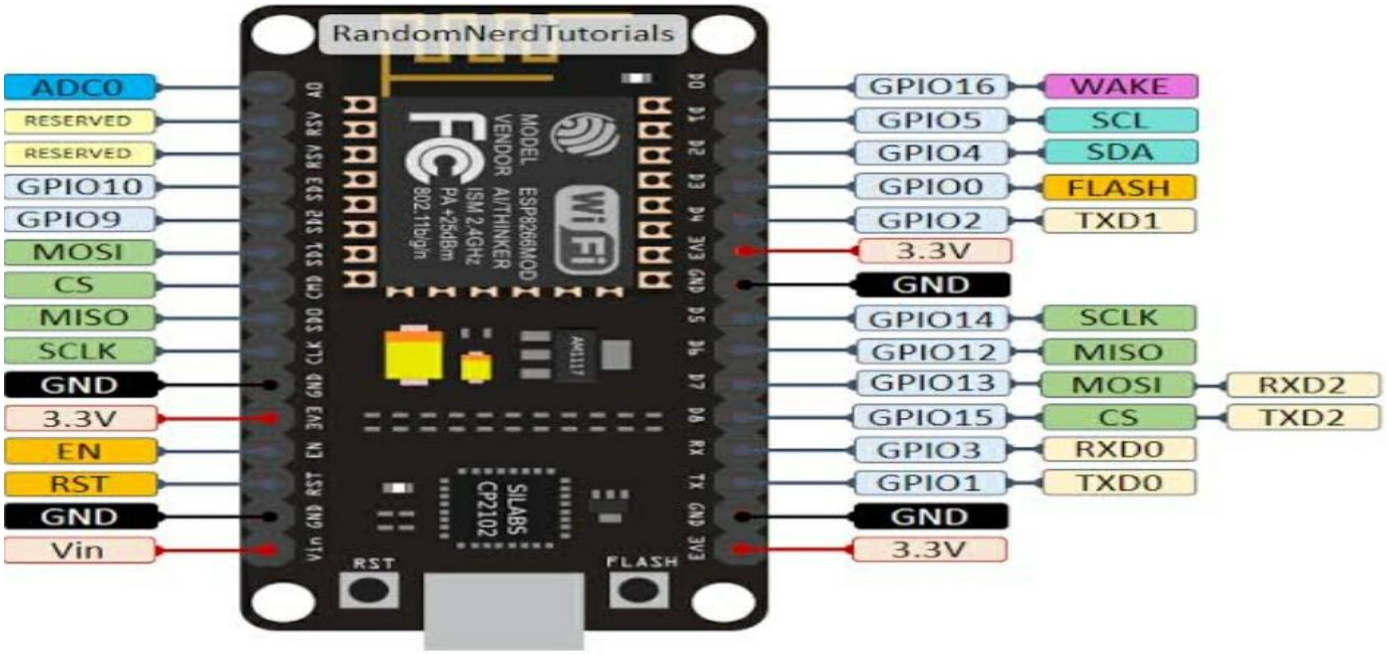
Arduino Uno is a microcontroller board based on the ATmega328P. It has 14 digital input/output pins (of which 6 can be used as PWM outputs), 6 analog inputs, a 16 MHz ceramic resonator (CSTCE16M0V53-R0), a USB connection, a power jack, an ICSP header and a reset button. It contains everything needed to support the microcontroller; simply connect it to a computer with a USB cable or power it with a AC-to-DC adapter or battery to get started.

Arduino uno is a low cost, flexible and easy-to-use programmable open source microcontroller board that can be integrated into a variety of electronic projects. This board can be interfaced with other Arduino boards, Arduino shields, Raspberry Pi boards and can control relays, LEDs, servos and motors as an output.

The program for any project on Arduino is done in embedded c language.

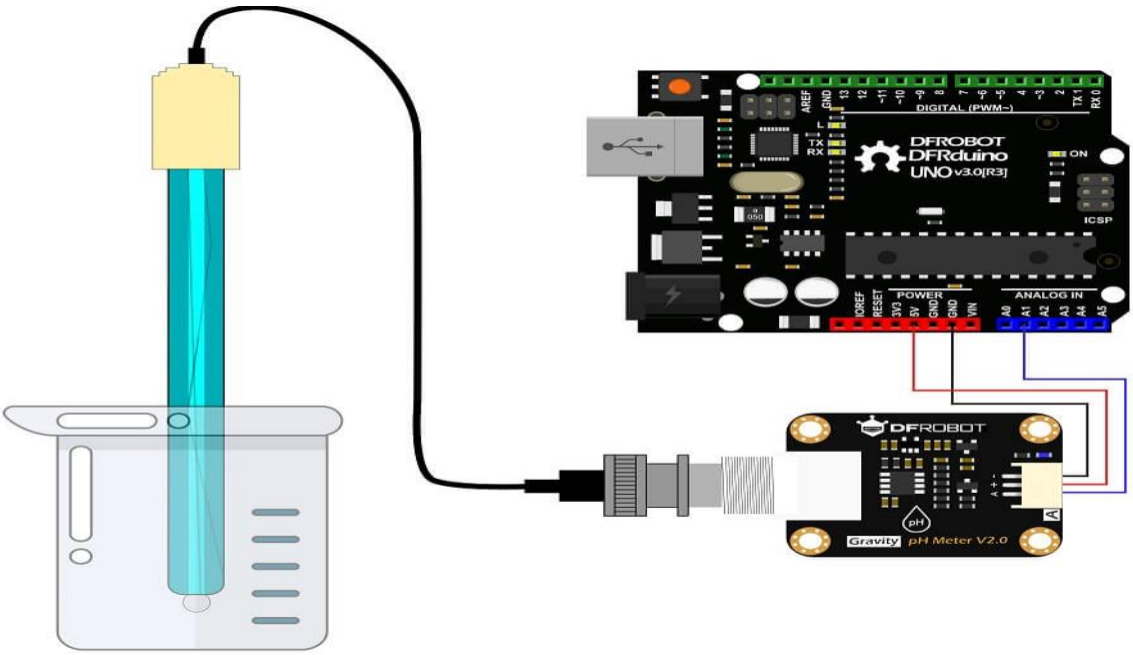


NODE MCU (ESP8266) :



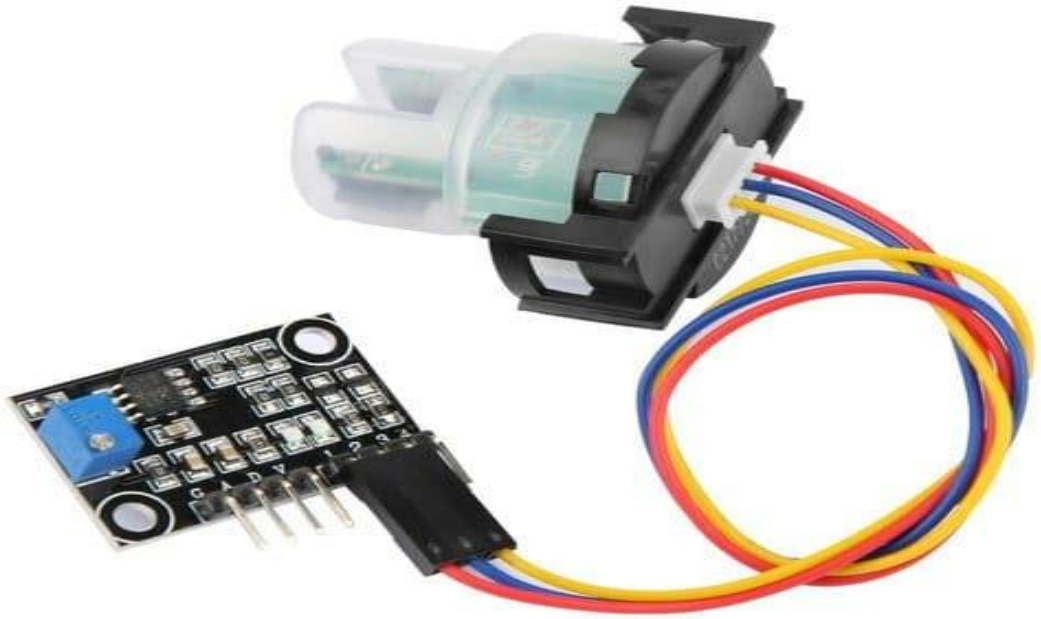
The ESP8266 NodeMcu has 16 GPIO pins and one analog pin shown in figure above. However only 10 of these GPIO pins can be used for digital input and output operations.

Ph SENSOR : It is used for checking the pH of water.



TEMPERATURE SENSOR: It senses the temperature and provide the output.

TURBIDITY SENSOR : These sensors measure the amount of light that is scattered by the suspended solids in water.



SOFTWARE REQUIREMENTS :

Arduino software : The **Arduino IDE** is a cross-platform application that is written in functions from C and C++. It is used to write and upload programs to Arduino compatible boards, but also, with the help of third-party cores, other vendor development boards.

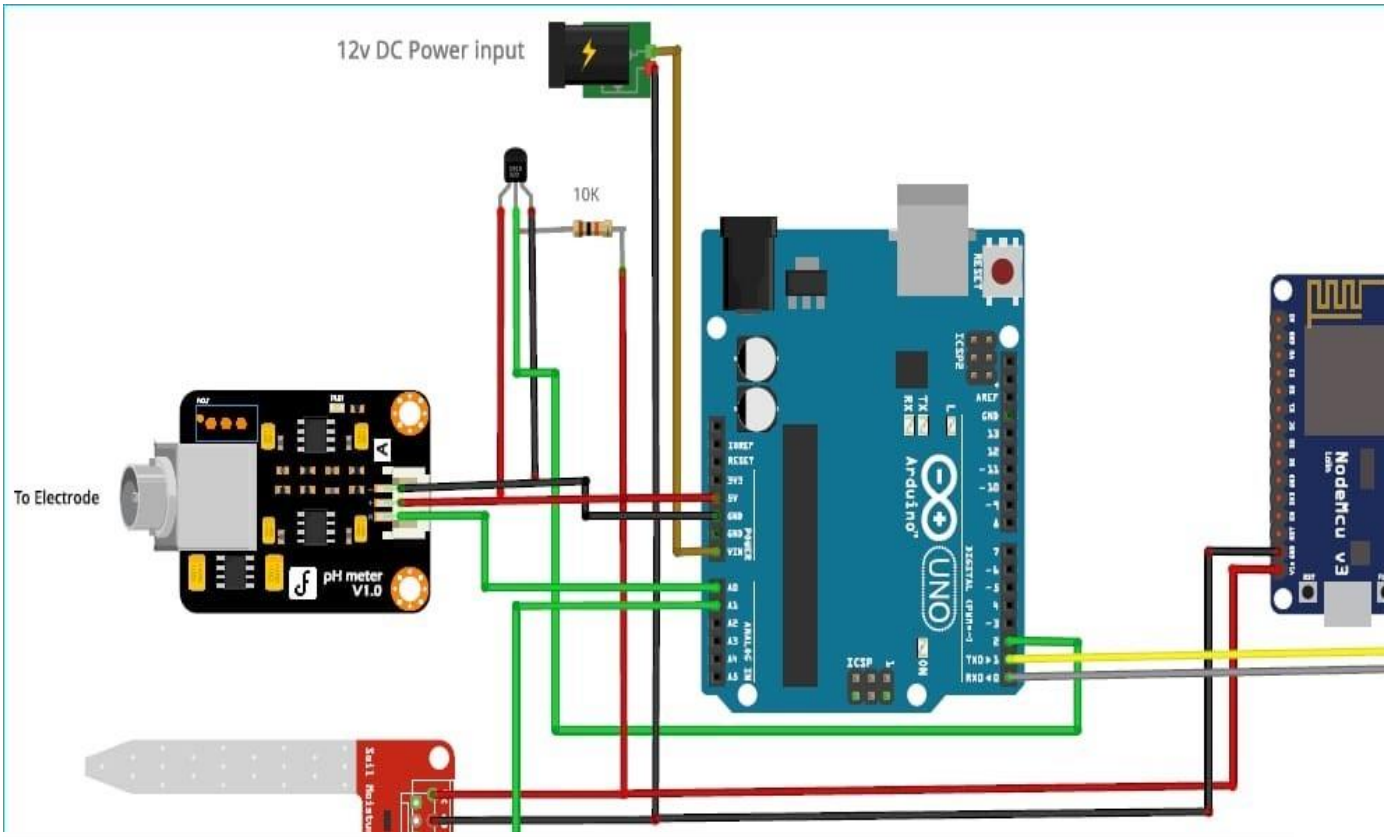
The Arduino IDE supports the languages C and C++ using special rules of code structuring. The Arduino IDE supplies a software library from the Wiring project, which provides many common input and output procedures. User-written code only requires two basic functions, for starting the sketch and the main program loop.

Arduino IDE has also provided IOT platform for projects using cloud.

Proteus software : This is the software used for software simulation instead of hardware simulation. The proteus design suite is a proprietary software tool suite used primarily for electronic design automation. The software is used mainly by electronic design engineers to create schematics and electronic prints for PCB manufacturing.

Libraries required for project simulation on Arduino are not in-built in the software, so we need to install all the required for project.

CIRCUIT RIG UP :



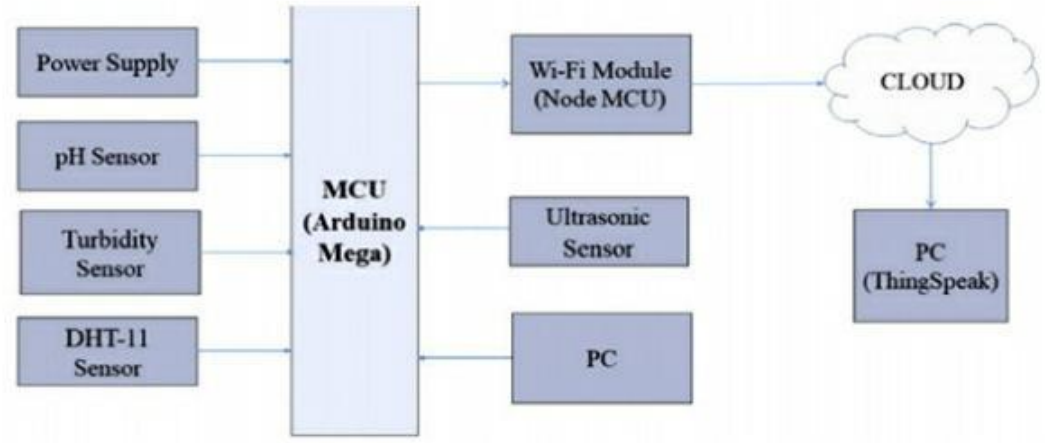


Fig: Block Diagram for WQMS

SOURCE CODE :

```
void getData(Data*data){
                                                    Serial.println(F("Hello Getting data:)"));
                                                    int Navg =20 ;
                                                    uint16_t datatemperature = 0;
                                                    uint16_t datapH = 0;
                                                    uint16_t dataDO = 0;
                                                    int dataturbidity = 0;

                                                    for(int i=0; i<Navg; i++){
                                                    datatemperature += analogRead(pinTemperature
                                                     datapH += analogRead(pinPH);
                                                     dataDO += analogRead(pinDO);
                                                     dataturbidity += analogRead(pinTurbidity);
                                                    }
                                                    datatemperature = datatemperature/Navg
                                                    datapH = datapH/Navg;
                                                    dataDO = dataDO/Navg;
                                                    dataturbidity = dataturbidity/Navg;

                                                           if( dataturbidity >= 703) {
                                                                   dataturbidity = 703;
                                                                   }









                                                    data->pH = (datapH*(5.0/1023.0)-0.88);
                                                    if (data->pH <0) data->pH = 0;


                                                    data->DO = (dataDO*(5.0/1023.0)-0.88);
                                                    if (data->DO <0) data->DO = 0;


                                                    data->temperature = (.88)-1.76)/1.76*5;




                                                    data->turbidity = (dataturbidity*-5.69) + 40
                                                    if (data->turbidity <0) data->turbidity = 0;
                                                    }
```

```
void printData(Data* data){
        Serial.print(F("Temperature is: "));
        Serial.println(data->temperature);
        Serial.print(F("pH is: "));
        Serial.println(data->pH);
        Serial.print(F("DO is: "));
        Serial.println(data->DO);
        Serial.print(F("Turbidity is: "));
        Serial.println(data->turbidity);
}
```

WORKING PRINCIPLE :

- The working principle behind this project is very simple which works depending on the capability of the sensors to sense the environment and give or display output on the cloud.
- Internet connecting devices should be correct so that the output is correct.
- The code is simple and understandable and the project works according to the logic provided in the code.
- Sensors ouput is uploaded to cloud which can be viewed at any place in the world
- When the sensors sense the change in the quality of water,the same is shown on the cloud platform.

IOT PLATFORM :

- An IOT Platform is a set of components that allows the developers to spread out the applications, remotely collect data , secure connectivity and execute sensor management. An IOT platform manages connectivity of the devices and allow developers to build new mobile software applications.

- IOT platforms can be created also in android phones which is in the form of application (Blynk app)

.

- An advantage of IOT platform is also provided in Arduino software in which we can create the variables used in the project and get the output for the particular time.

FUTURE DEVELOPMENTS :

- The system can be expanded to monitor Hydrologic, air pollution, industrial and agricultural production and so on

- Same work with some modifications can be carried out to include controlling the supply of water.

- Water Quality Monitoring System must get such advanced that it should first check the quality and then should also treat the water as per the requirements.

APPLICATIONS OF IOT :

The major projects are developed in the following fields :

- ❖ Wearables
- ❖ Health
- ❖ Traffic Monitoring
- ❖ Fleet Management
- ❖ Agriculture
- ❖ Hospitality
- ❖ Smart grid and Energy Saving
- ❖ Water supply

APPLICATIONS OF WQMS :

- WQMS system is used in the field of agriculture during the process of irrigation.
- The use of the system in domestic applications reduces health risks.
- The project is used in protection of water system of the globe.
- This system helps in the protection of aquatic life and ecosystem.

ADVANTAGES OF WQMS :

- Ease and convenience of usage.
- Modern WQMS analyse data continually and instantly alert users to changes in the system, giving peace of mind and reducing the need for unreliable and expensive sampling.
- Helps determine whether or not we are making progress in cleaning up our waterways.
- It reveals the health and composition of streams, lakes, rivers at a snapshot in time.
- Water quality standards also protect iconic, locally grown crops.
- This protects the aquatic life which in turn protects the ecosystem.
- Water quality standards protects human health and avoid cost related to medical care, productivity loss, and even loss of life
- The major advantage of this system is in the field of agriculture.

DISADVANTAGES OF WQMS :

- Water is not monitoring seamlessly and it always needs a human intervention.
- The system cost is very high.
- The system has to be checked manually periodically.

CONCLUSION :

- Firstly, the need for water quality measure was briefed and then the perfect model to solve the process was determined.
- The project rig up, components and all the sensors required for execution is explained.
- Monitoring of turbidity ,pH and temperature of water made the people about the water quality.
- The system developed here would definitely be useful in present by providing information and also in future for further developments.
- The system can monitor water quality automatically and it is low in cost and does not require people on duty. The has a good flexibility.

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