Smart Water Monitoring System

Mini Project Report submitted in partial fulfillment.

of the requirement for the degree of

T. E. (Information Technology)

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CERTIFICATE OF APPROVAL

For

Mini Project Report

On

Sensor Network Lab

This is to Certify that

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Have successfully carried out Mini Project entitled

“**Smart Water Monitoring System**”

In partial fulfillment of degree course in

Information Technology

As laid down by University of Mumbai during the academic year 2020-21

Under the Guidance of
“Prof. Vinita Bhandiwad”

Signature of Guide

Head of Department

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Examiner 2

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The days we have spent in the institute will always be remembered and also be reckoned as guiding in our career.

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Abstract

Water is one of the most important substances on earth. People now days always want something that can make their life easier. In this thesis is used to define the smart water monitoring systems such as water parameter sensing monitoring, water pollution monitoring and water pipeline leakage sensing monitoring. The microcontroller based Water monitoring is used to indicate the parameter of water in the agent. Sensor Based Water Detection, it will check the water quality by using these parameters such as the pH level, humidity and temperature are measured in real time by the sensors and it will monitoring by an agent. This thesis our motivation is to prevent the water by using technologies and the monitoring system uses daily life device like laptop or mobile phone.

Introduction

Measuring different parameters of soil and water for efficient harvesting using sensor. Modern smart water monitoring systems analyze data continually and instantly alert users to changes in the system, giving peace of mind and reducing the need for unreliable and expensive sampling. Smart systems are also designed to be easy-to-use, allowing easy access of all the data in one place, accessible via any internet enabled device. Without a smart water monitoring system, sampling is the main way water quality checks take place. The problem with sampling is that results can take weeks to come back, by which time conditions may have changed.

Using real-time monitoring, instant data allows pre-cursors to potential issues (such as corrosion) to be flagged up and immediately be addressed before major issues occur. The ability to make real-time decisions during critical moments can be vital in preventing expensive repairs and breakdown. Smart meters have already become an essential component of the modern-day electrical grids and are now finding their way in the water utilities. Currently, in a world where people are perishing due to lack of water, these meters are the breakthrough innovation that water utilities can use to provide everyone with potable water.

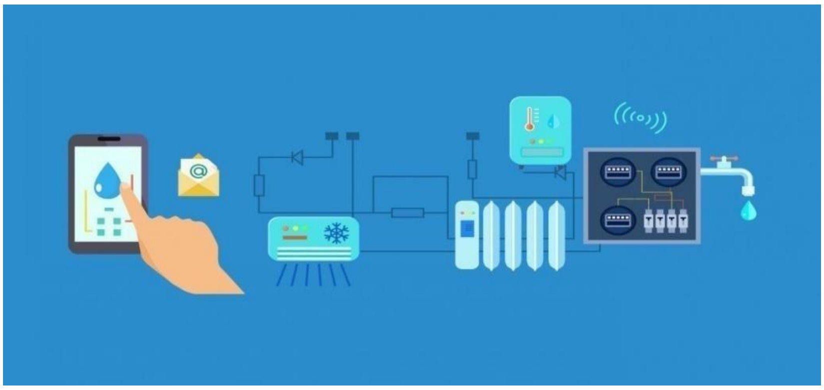
Water is a limited resource and is essential for agriculture, industry and for creature existence on earth including human beings. Lots of people don't realize the true importance of drinking enough water every day. More water are wasted by many uncontrolled way. This problem is quietly related to poor water allocation, inefficient use, and lack of adequate and integrated water management. Therefore, efficient use and water monitoring are potential constraint for home or office water management system.

Aim and Objects

Unlike traditional water gauges, smart water meters are a part of a wide area network that allow utilities and consumers to engage in two-way communication. These meters help water suppliers to enhance their water distribution network and incorporate robust water conservation & management practices. In the operational, industrial and consumer vertical, these meters offer numerous benefits. Let us go through some of these advantages: These smart water meters with sensors supports a two-way interaction between water distributors and end consumers. This means that the water supplier can monitor the consumption of individual houses that are connected to its network in real-time. Customers Identifying Consumption inefficiencies identifying consumption patterns and inefficiencies is another application of smart meters. Water utilities and suppliers generally lack clear transparency in their water conservation attempts. Reduction in Non-Revenue Water.

The main causes that contribute to the non-revenue water are:

- Leaks
- Theft
- Meter inefficiencies
- Water main break



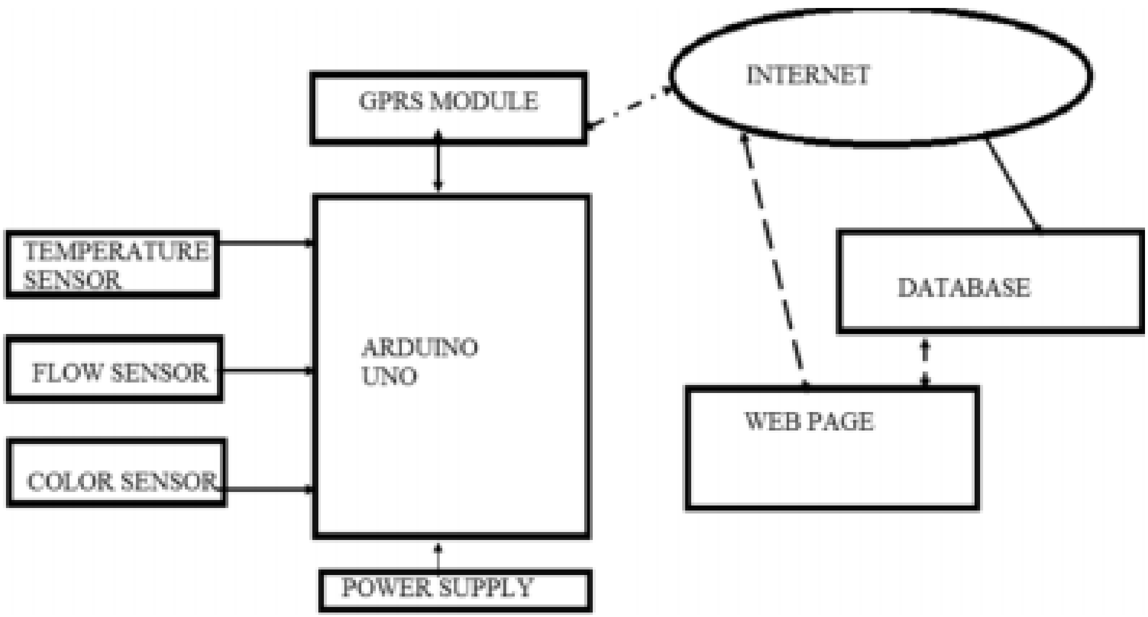
Problem Definition

Agriculture is the backbone of our country and it is very important to know the parameter of soil and water for efficient harvesting. The various parameters that can be monitored are Soil moisture, pH of water, Temperature, etc. We previously measured these parameters in different tutorials but today we will not only combining them but also display them on a webpage so that they can be monitored from anywhere in the world. Water monitoring is a crucial part of maintaining many environments including industrial buildings, commercial properties and healthcare establishments. Technology has advanced to the extent that there are now highly sophisticated, accurate and convenient smart water monitoring systems which offer a whole host of benefits to property owners. If sampling is the sole way that water quality is checked, there is unfortunately always the prospect of human error. Results are open to interpretation and represent a snap shot in time, rather than a full picture of a number of days or weeks.

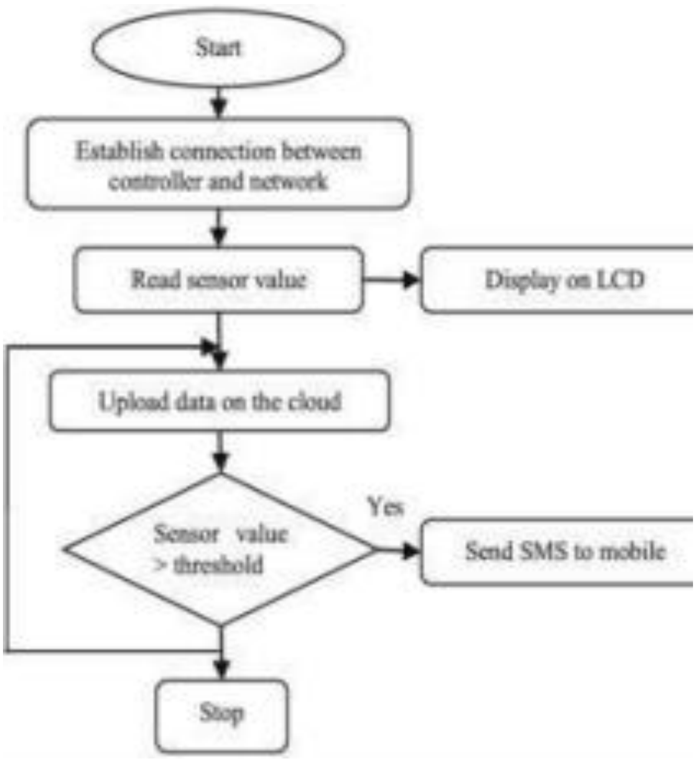
With advanced water monitoring technology, highly accurate measurements allow building managers, FMs and maintenance teams to detect and gather more data, including dissolved oxygen – a pre-cursor to all types of corrosion. Smart systems are also designed to be easy-to-use, allowing easy access of all the data in one place, accessible via any internet enabled device.

Proposed System

4.1 Block Diagram



4.2 Flow Chart



Components

5.1 Hardware

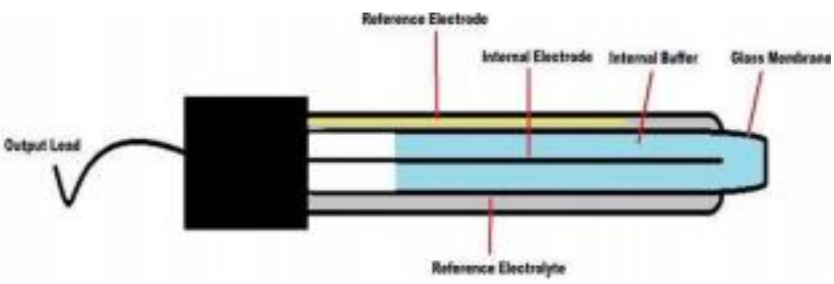
1. NodeMCU

NodeMCU v3 is a development board which runs on the ESP8266 with the express if   non OS, SDK, and hardware based on the ESP-12 module. The device features 4MB of flash memory, 80MHz of system clock, around 50k of usable RAM and an on chip WIFI Transceiver.

Fig 5.1.1 NodeMCU

2. pH Electrode

The construction of a pH sensor is shown above. The **pH Sensor** looks like a rod usually made of a glass material having a tip called “Glass membrane”. This membrane is filled with a buffer solution of known pH (typically pH = 7). This electrode design ensures an environment with the constant binding of H+ ions on the inside of the glass membrane. When the probe is dipped into the solution to be tested, hydrogen ions in the test solution start exchanging with other positively charged ions on the glass membrane, which creates an **electrochemical potential** across the membrane.



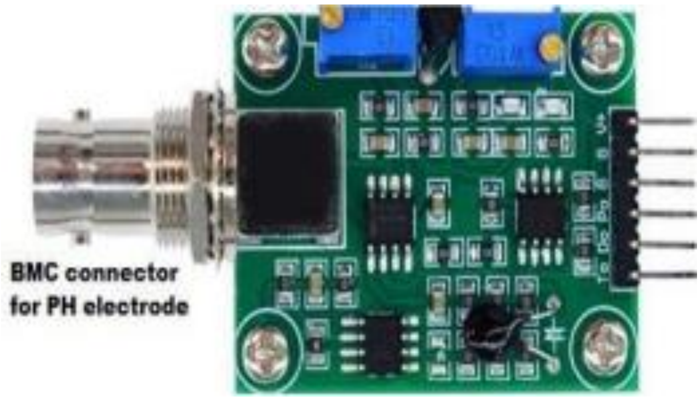


Fig 5.1.2 pH electrode

3. Temperature Sensor

DS18B20 is a single wire temperature sensor, as this can be interfaced with microcontroller or Arduino using single data wire. This is available in a waterproof and Non-waterproof format.

Technical Specifications:

- Temperature range: -55 to 125°C
- Bit selectable resolution: 9-12 bit
- 1-Wire interface
- Unique 64-bit address enables multiplexing

- Accuracy: ±0.5°C
- Operating Voltage: 3-5 VDC
- Conversion time: 750ms at 12-bit

Fig 5.1.3 Temperature Sensor

5.2 Software

1. Arduino IDE

The Arduino integrated development environment (IDE) is a cross-platform application (for Windows, macOS, Linux) that is written in the programming language Java. It is used to write and upload programs to Arduino compatible boards, but also, with the help of 3rd party cores, other vendor development boards.

Fig 5.2.1 Arduino Ide

2. Blynk App

Blynk is a new platform that allows you to quickly build interfaces for controlling and monitoring your hardware projects from your IOS and Android device. After downloading the Blynk app, you can create a project dashboard and arrange buttons, sliders, graphs, and other widgets onto the screen. Using the widgets, you can turn pins on and off or display data from sensors.

Fig 5.2.2 Blynk App

Logic

The unit that we use to measure the **acidity** of a substance is called **pH.** The term “H” is defined as the negative log of the hydrogen ion concentration. The range of pH can have values from 0 to 14. A pH value of 7 is neutral, as pure water has a pH value of exactly 7. Values lower than 7 are acidic and values greater than 7 are basic or alkaline.

Analog pH sensor is designed to measure the pH value of a solution and show the acidity or alkalinity of the substance. It is commonly used in various applications such as agriculture, wastewater treatment, industries, environmental monitoring, etc. The module has an on-board voltage regulator chip which supports the wide voltage supply of 3.3-5.5V DC, which is compatible with 5V and 3.3V of any control board like Arduino. The output signal is being filtered by hardware low jitter. We previously used a PH sensor with Arduino to measure the pH value of liquid solution.

Technical Features:

Signal Conversion Module:

- Supply Voltage: 3.3~5.5V
- BNC Probe Connector
- High Accuracy: ±0.1@25°C
- Detection Range: 0~14

Code

```
#include <OneWire.h>

#include <DallasTemperature.h>

#include <ArduinoJson.h>

OneWire oneWire(2);

DallasTemperature temp_sensor(&oneWire);

float calibration_value = 21.34;

StaticJsonBuffer<1000> jsonBuffer;

JsonObject& root = jsonBuffer.createObject();

for(int i=0;i<10;i++)

 {

 buffer_arr[i]=analogRead(A0);

 delay(30);

 }

for(int i=0;i<9;i++)

 {

 for(int j=i+1;j<10;j++)

 {

 if(buffer_arr[i]>buffer_arr[j])

 {

 temp=buffer_arr[i];

 buffer_arr[i]=buffer_arr[j];

 buffer_arr[j]=temp;

 }

 }
```

```
 }

for(int i=2;i<8;i++)

 avgval+=buffer_arr[i];

 float volt=(float)avgval*5.0/1024/6;

 float ph_act = -5.70 * volt + calibration_value;

temp_sensor.requestTemperatures();

int moisture_analog=analogRead(A1);

int moist_act=map(moisture_analog,0,1023,100,0);

root["a1"] = ph_act;

root["a2"] = temp_sensor.getTempCByIndex(0);

root["a3"] = moist_act;

root.printTo(Serial);

Serial.println("");
```

Implementation

6.1 Working

Arduino Programming:

First of all, include all the header files, which will be required throughout the code. Here we are using**onwire. h**and**Dallas Temperature. h**library for a DS18B20 temperature sensor. This can be downloaded from the links given and included in the Arduino library. Similarly, we are using **ArduinoJson. h**library for sending JSON data from the transmitter to the receiver side.

Next, define the connection pin of Arduino, where the output pin of the DS18B20 sensor will be connected, which is digital pin 2 in my case. Then, objects for ***onewire*** class and ***DallasTemperature*** class are defined which will be required in the coding for temperature measurement.

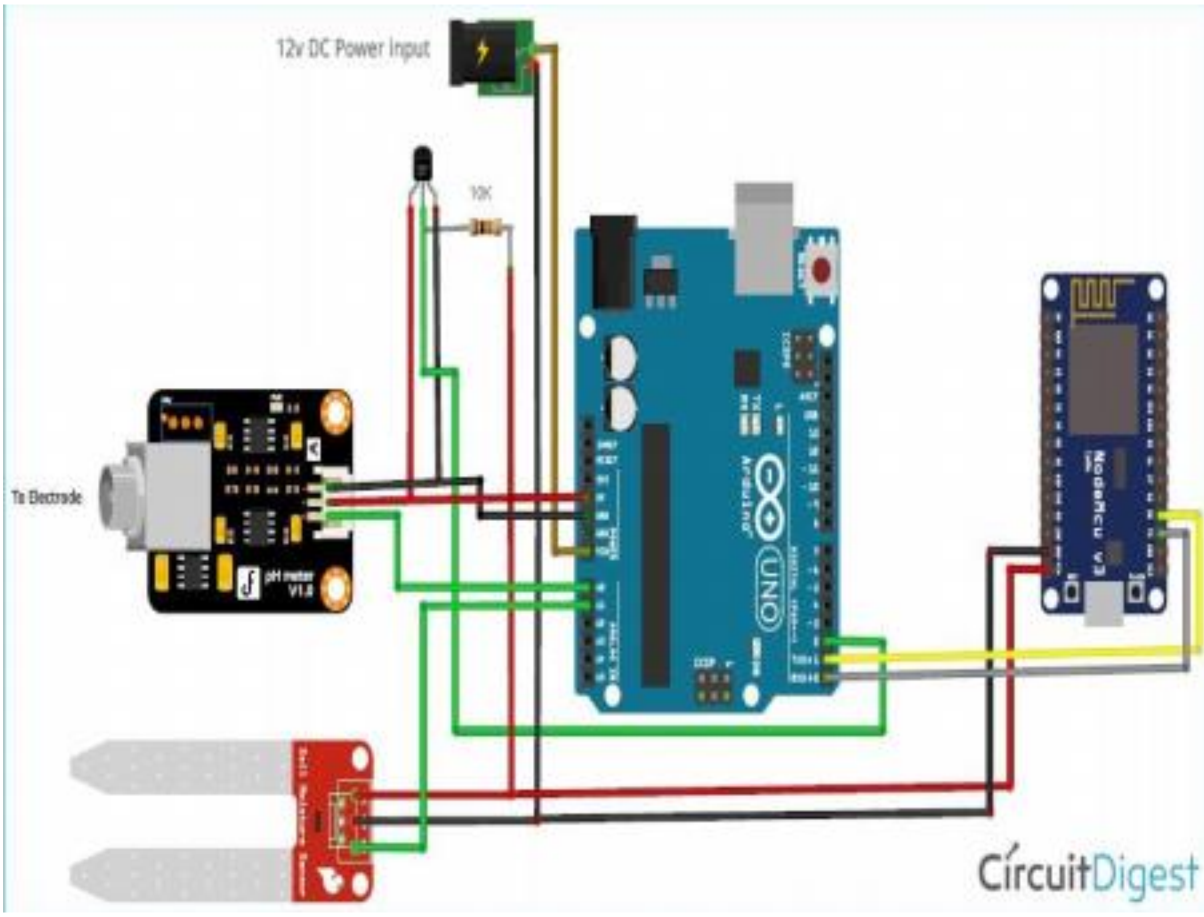
Next, the calibration value is defined, which can be modified as required to get an accurate pH value of solutions. Inside ***loop(),***read 10 sample Analog values and store them in an array. This is required to smooth the output value.

Then, we have to sort the Analog values received in ascending order. This is required because we need to calculate the running average of samples in the later stage.

Finally, calculate the average of a 6 center sample Analog values. Then this average value is converted into actual pH value and stored in a variable.

Now, analog values from the soil moisture sensor are read and this is mapped to percentage using ***map()*** function.

6.1 Circuit Diagram



There are two parts of programming in this Smart Water Monitoring System using sensor. In the first part, Arduino is programmed and in the second part, NodeMCU will be programmed. Complete code for both Arduino and NodeMCU along with the video is given at the end of this tutorial.

Deployment of Testing

Parameters	Value	Units
PH Value	3	N/A
Temperature	31	Centigrade
Moisture	1	%

So this is how a smart water quality monitoring system can be built easily with few components. The developed system having Arduino Mega and NodeMCU target boards are interfaced with several sensors successfully. An efficient algorithm is developed in real-time, to track water quality.

The problem with sampling is that results can take weeks to come back, by which time conditions may have changed. Using real-time monitoring, instant data allows pre-cursors to potential issues (such as corrosion) to be flagged up and immediately be addressed before major issues occur.

<u>Conclusion & Future Scope</u>

Smart meters are changing the way utilities operate—let it be the energy or water segment. The use of these meters along with a well-crafted sensor solution allow water utilities to manage their water distribution practices and provide their customers with clean potable water. These meters are also empowering the consumers to see the value of water meter in reducing cost linked with their consumption of water. Thus this proves that this sensor project can effectively measles parameters of soil and water for effective harvesting.

1. Prevent Legionella with flow sensor monitoring.

2. Maintain a continuously healthy water supply with sensor water quality monitoring system.

3. Detect and fix wasteful leaks with flow monitoring.

Every year, <u>millions of gallons of water are waste</u> due to leakage, meter errors, and operational inefficiencies. Many facilities managers rely on regular inspections of the pipes to identify failures, but that could mean a leak isn't caught for several months after it begins. Sensor water flow sensors can help identify leaks immediately by measuring the flow of water through a pipe and its rate of change. When sensor data shows a change in the normal rate, it could be an indicator of a pipe leakage or other operational malfunction, giving building managers a chance to address problems before too much water is wasted.