WATER POLLUTION CONTROL USING IOT

A PROJECT REPORT

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ABSTRACT

This widespread problem of water pollution is jeopardizing our health. In order to ensure the safe supply of the drinking water the quality needs to be monitor in real time. This project mainly focuses on how different sensors connected to a server and database helps in identifying whether the water stored in different storage tanks like overhead tanks are suitable for human consumption. It uses a real time monitoring of water quality in Internet of things (IOT) using different sensor for the physical and chemical measure of water including turbidity, temperature, pH and flow sensor. The measured values from the sensors can be processed by the core controller. The Arduino model can be used as a core controller. The traditional methods of water quality monitor involve the manual collection of water samples from different locations. The project has basically set different standards for different values of sensor so over a period of average values of these sensors will decide whether the water is polluted or not and inform the user you change the water from the stored tank and if required clean the storage tank/area. Finally, the output will be displayed through various colored led which determine the quality of water.

List of Figures

1. INTRODUCTION-

Drinking water quality observing is basic before utilization in everyday life as it influences straightforwardly or in a roundabout way human wellbeing. The water emergency has become a worldwide issue as of late, it isn't constrained to a specific locale or nation. Before the finish of 2025, half of the total populace will live in water-focused on regions (World Health Organization (WHO), 1996). In creating nations, as much as 80% of sicknesses are connected to low-quality water and 20 sanitation conditions. India is one of the most water-tested nations, among creating nations on the planet. An answer in such manner is critical and this undertaking centers on the previously mentioned issues obliging all the specialized and financial viewpoints. The task features the whole water quality observing techniques, sensors, implanted plan, and data dissemination methodology, job of government, organize administrator and townspeople in guaranteeing appropriate data dispersal. While consequently improving the water quality isn't possible now, productive utilization of innovation and monetary practices can help improve water quality and mindfulness among individuals.

In the 21st century, there were loads of innovations, and yet were contaminations, a worldwide temperature alteration, etc are being shaped, on account of this there is no sheltered drinking water for the world's contamination. These days, water quality observing progressively faces difficulties in view of an unnatural weather change constrained water assets, developing populace, and so forth. Henceforth there is a requirement for growing better procedures to screen the water quality parameters progressively. The water quality parameters pH estimates the convergence of hydrogen particles. It shows the water is acidic or antacid. Unadulterated water has 7pH esteem, under 7pH has acidic, more than 7pH has antacid. The scope of pH is 0-14 pH. For drinking reason, it ought to be 6.5-8.5pH. Turbidity estimates an enormous number of suspended particles in water that is undetectable. Higher the turbidity higher the danger of looseness of the bowels, cholera. Lower the turbidity then the water is perfect. Temperature sensor estimates how the water is, hot or cold. Stream sensor estimates the progression of water through the stream sensor. The customary techniques for water quality screen include the manual gathering of water tests from various areas.

Clean water is one of the most significant assets required to support life and the nature of drinking water assumes a significant job in the prosperity and soundness of people. Water supply to taps at urban homes and water sources accessible in increasingly country regions, is, be that as it may, not really ok for utilization. Despite the fact that it is the administration's obligation to guarantee that perfect water is conveyed to its residents, regularly maturing foundation, which is inadequately kept up, and a consistent increment in populace puts a strain on the inventory of clean water.

Water quality checking can be accomplished through microbial estimations just as physiochemical estimations. Physiochemical parameters incorporate electrical conductivity, pH, oxidation-decrease potential, turbidity, temperature, chlorine substance and stream. These parameters can be broke down rapidly and at less cost than the microbial parameters and can likewise be estimated with on-line instrumentation.

The conventional techniques for water quality screen include the manual accumulation of water tests from various areas. The task has essentially set various norms for various estimations of the sensor so over a time of normal estimations of these sensors will choose whether the water is dirtied or not and educate the client you change the water from the put away tank and whenever required clean the capacity tank/region. At long last, the yield will be shown through different shaded drove which decides the nature of water.

Nikhil Kedia entitled "Water Quality Monitoring for Rural Areas-A Sensor Cloud-Based Practical Project." Published in 2015 first International Conference on Next Generation Computing Technologies (NGCT-2015) Dehradun, India. This paper features the whole water quality checking strategies, sensors, implanted structure, and data dispersal method, the job of government, organize administrator and locals in guaranteeing appropriate data scattering. It likewise investigates the Sensor Cloud space. While naturally improving the water quality isn't attainable now, proficient utilization of innovation and monetary practices can help improve water quality and mindfulness among people.[1]

2. Background of the Work

Nikhil Kedia entitled "Water Quality Monitoring for Rural Areas-A Sensor Cloud-Based Practical Project." Published in 2015 first International Conference on Next Generation Computing Technologies (NGCT-2015) Dehradun, India. This paper features the whole water

quality checking strategies, sensors, implanted structure, and data dispersal method, the job of government, organize administrator and locals in guaranteeing appropriate data scattering. It likewise investigates the Sensor Cloud space. While naturally improving the water quality isn't attainable now, proficient utilization of innovation and monetary practices can help improve water quality and mindfulness among people.[1]

Jayti Bhatt, Jignesh Patoliya entitled "Constant Water Quality Monitoring System".This paper depicts guaranteeing the protected inventory of drinking water the quality ought to be checked progressively for that reason new approach IoT (Internet of Things) based water quality observing has been proposed. In this paper, we present the plan of an IoT based water quality checking framework that screens the nature of water continuously. This framework comprises of certain sensors which measure the water quality parameter, for example, pH, turbidity, conductivity, broke up oxygen, temperature. The deliberate qualities from the sensors are handled by microcontroller and these prepared qualities are transmitted remotely profoundly controller that is raspberry pi utilizing Zigbee convention. At long last, sensors information can see on web program application utilizing cloud computing.[2]

Michal Lom, Ondrej Pribyl, Miroslav Svitek entitled "Industry 4.0 as a Part of Smart Urban communities". This paper depicts the combination of the Smart City Initiative and the idea of Industry 4.0. The term shrewd city has been a wonder of the most recent years, which is extremely bent particularly since 2008 when the world was hit by the money related emergency. The principle explanations behind the development of the Smart City Initiative are to make a feasible model for urban areas and save the personal satisfaction of their residents. The theme of the brilliant city can't be considered uniquely to be a specialized control, yet extraordinary financial, philanthropic or lawful perspectives must be included also. In the idea of Industry 4.0, the Internet of Things (IoT) will be utilized for the advancement of purported keen items. Subcomponents of the item are outfitted with their own knowledge. Included knowledge is utilized both during the assembling of an item just as during ensuing dealing with, up to ceaseless checking of the item lifecycle (shrewd forms). Other significant parts of the Industry 4.0 are Internet of Services (IoS), which incorporates particularly wise vehicle and coordinations (brilliant portability, savvy coordinations), just as Internet of Energy (IoE), which decides how the common assets are utilized in appropriate way (power, water, oil, and so forth.). IoT, IoS, IoP and IoE can be considered as a component that can make an association of the Smart City Initiative and Industry 4.0 – Industry 4.0 can be viewed as a piece of brilliant cities.[3]

Zhanwei Sun, Chi Harold Li, Chatschik Bisdikian, Joel W.Branch and Bo Yang entitled "QOI-Aware Energy Management in Internet-of-Things Sensory Environments". In this paper, a proficient vitality the executive's structure to give good QOI involvement with IoT tactile conditions is contemplated. In spite of past endeavours, it is straightforward and perfect with lower conventions being used and protecting vitality effectiveness over the long haul without giving up any achieved QOI levels. In particular, the new idea of QOI-mindful "sensor-to-task significance" to unequivocally consider the detecting capacities offered by a sensor to the IoT tactile conditions, and QOI prerequisites required by an assignment. A tale idea of the "basic covering set" of some random undertaking in choosing the sensors to support an errand after some time. Vitality the executives choice is made powerfully at runtime, as the ideal for long haul traffic measurements under the limitation of the administration delay. At last, a broad contextual investigation dependent on using the sensor systems to perform water level checking is given to exhibit the thoughts and calculations proposed in this paper, and a reenactment is made to show the presence of the proposed algorithms.[4]

Sokratis Kartakis, Weiren Yu, Reza Akhavan, and Julie A. McCann entitled "Versatile Edge Analytics for Distributed Networked Control of Water Systems" This paper shows the burst location and restriction plot that joins lightweight pressure and inconsistency discovery with diagram topology examination for water circulation systems. We show that our methodology not just fundamentally decreases the quantity of interchanges between sensor gadgets and the back end servers, yet in addition can successfully restrict water burst occasions by utilizing the distinction in the appearance times of the vibration varieties recognized at sensor areas. Our outcomes can set aside to 90% of interchanges contrasted and customary periodical announcing situations.[5]

3. Overview of the Work

3.1. Problem description –

There were loads of innovations, and yet were contaminations, a worldwide temperature alteration, etc are being shaped, on account of this there is no sheltered drinking water for the world's contamination. These days, water quality observing progressively faces difficulties in view of an unnatural weather change constrained water assets, developing populace, and so forth. Henceforth there is a requirement for growing better procedures to screen the water quality parameters progressively. The water quality parameters pH estimates the convergence of hydrogen particles. It shows the water is acidic or antacid. Unadulterated water has 7pH esteem, under 7pH has acidic, more than 7pH has antacid. The scope of pH is 0-14 pH. For drinking reason, it ought to be 6.5-8.5pH. Turbidity estimates an enormous number of suspended particles in water that is undetectable. Higher the turbidity higher the danger of looseness of the bowels, cholera. Lower the turbidity then the water is perfect. Temperature sensor estimates how the water is, hot or cold. Stream sensor estimates the progression of water through the stream sensor. The customary techniques for water quality screen include the manual gathering of water tests from various areas.

3.2. Working model-

3.2.1. **Turbidity Sensor:**

Turbidity is a measure of the cloudiness of water. Turbidity has indicated the degree at which the water loses its transparency. It is considered as a good measure of the quality of water. Turbidity blocks out the light needed by submerged aquatic vegetation. It also can raise surface water temperatures above normal because suspended particles near the surface facilitate the absorption of heat from sunlight.

Figure 1

The module is to be connected to Arduino using three pins only: VCC, GND and SIGNAL. Here is an example Fritzing diagram where the turbidity sensor is connected to an Arduino UNO:

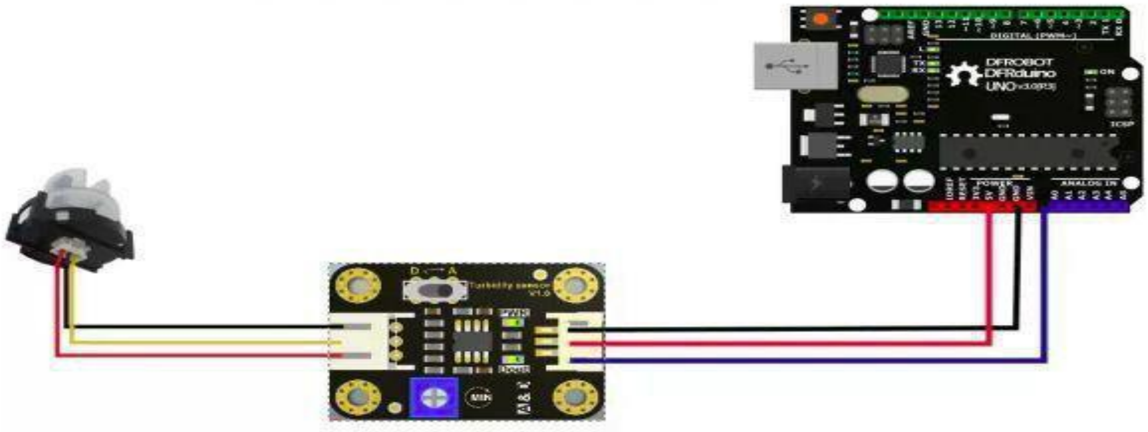

Figure 2

Nephelometric Turbidity Unit is the unit in which the sensor reads the data from water which is further converted to voltage while giving the output. The relation between these units are given by the below graph:

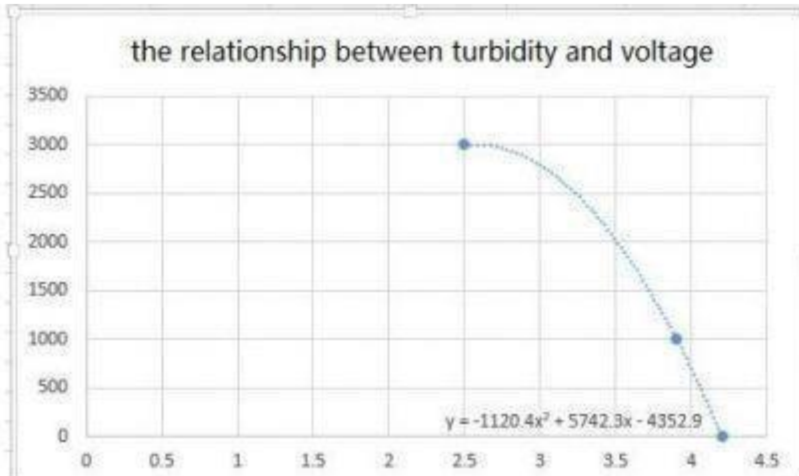

Figure 3

However, this equation (presumably acquired through curve fitting) is only applicable when the sensor gives out around approximately 4.2 volts at no turbidity.

3.2.2. **Temperature Sensor:**

Fig: Temperature sensor

Figure 4

Water Temperature indicates how water is hot or cold. The range of DS18B20 temperature sensor calibrates directly in Celsius and can be converted to give temperature in Fahrenheit also. It is based on Linear +10-mV/Celsius. The range for the sensor is −55°C to 150°C. It is also suitable for remote applications.

The sensor is connected to the Arduino in the following example:

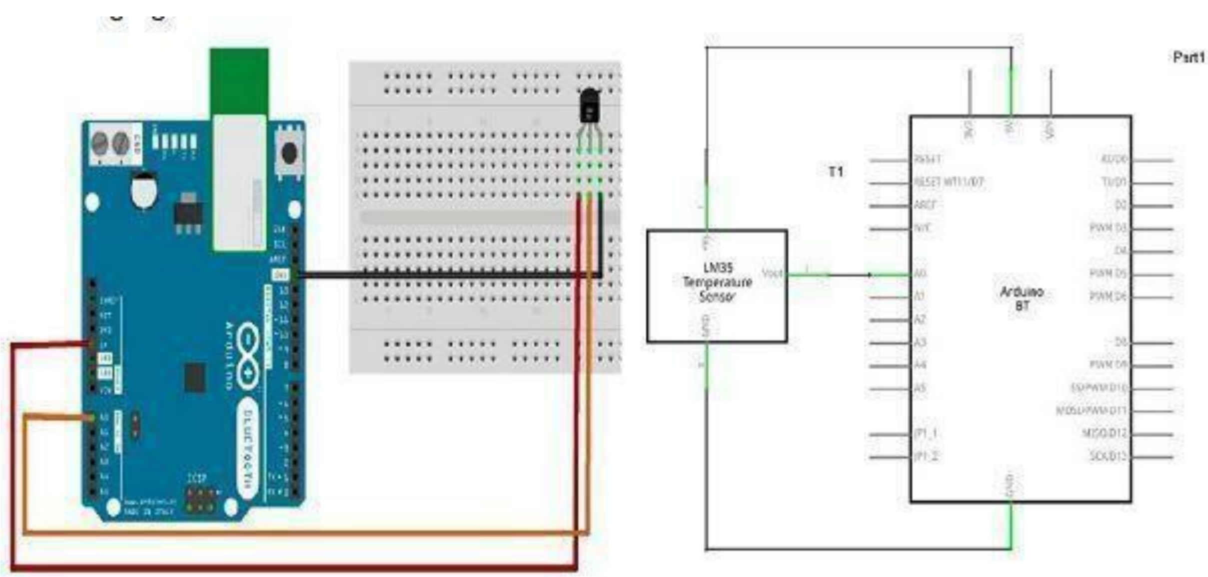

Figure 5

3.2.3. **Flow Sensor:**

Flow sensor is used to measure the flow of water through the flow sensor. This sensor basically consists of a plastic valve body, a rotor and a Hall Effect sensor. The pinwheel rotor rotates when water / liquid flows through the valve and its speed will be directly proportional to the flow rate.

Figure 6

Connecting the water flow sensor to arduino requires minimal interconnection. Connect the VCC (Red) and GND (Black) wires of the water flow Sensor to the 5v and Gnd of Arduino, and link Pulse Output (Yellow) wire of the water flow sensor to Arduino digital pin 2. Note that the water flow sensor is not a power-hungry type; it draws a maximum of 15-20 mA at 5V DC input!

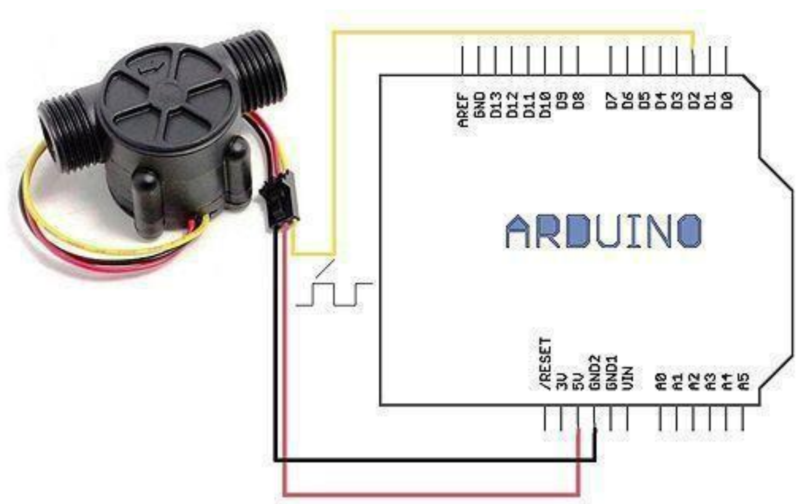

Figure 7

3.2.4. **pH Sensor:**

We use the SEN0161 pH sensor in this. Here is the circuit diagram:

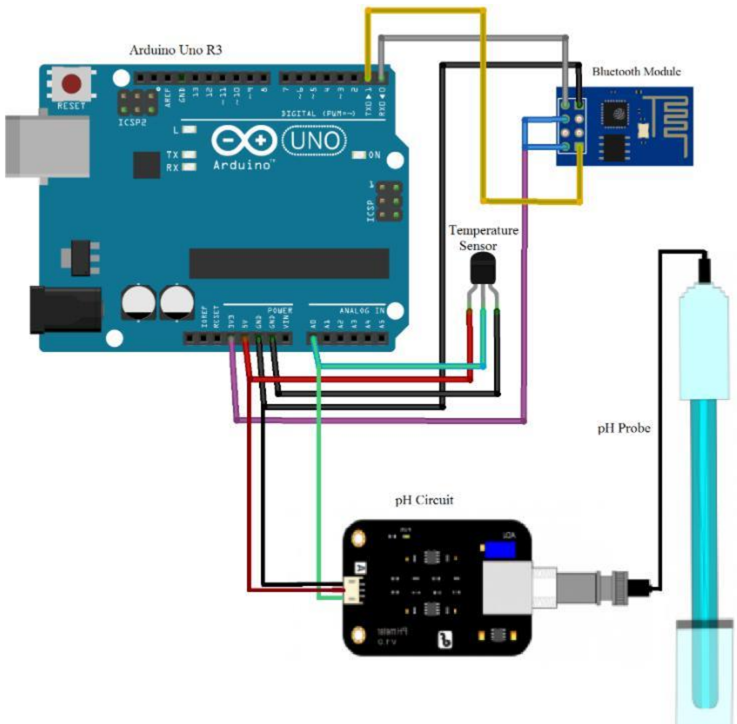

Figure 8

3.2.5. **LED Bulb**

An LED is a small light (it stands for "light emitting diode") that works with relatively little power. The Arduino board has one built-in on digital pin 13. Although we will be using pin 12 in this case along with 220 ohm resistor. The LED. The connection as shown below:

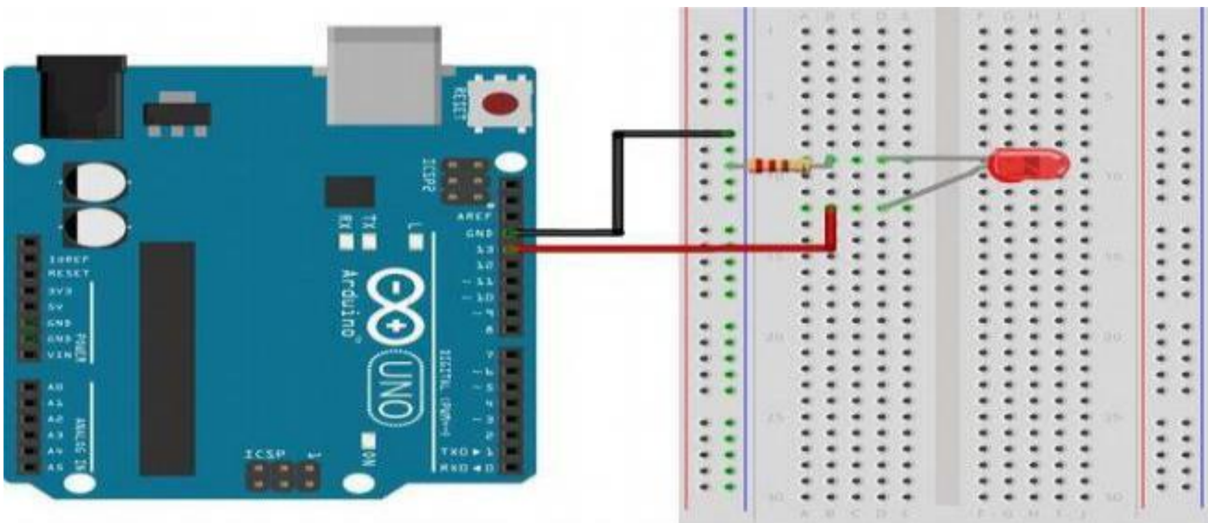

Figure 9

3.2.6. **Arduino UNO**

Arduino Uno: Arduino 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 quartz crystal, a USB connection, a power jack, an ICSP header and a reset button. It contains everything needed to support the microcontroller. Arduino Software (IDE) were the reference versions of Arduino, now evolved to newer releases. The Uno board is the first in a series of USB Arduino boards, and the reference model for the Arduino platform; for an extensive list of current, past or outdated boards see the Arduino index of boards.

Figure 10

3.4.Overall System view

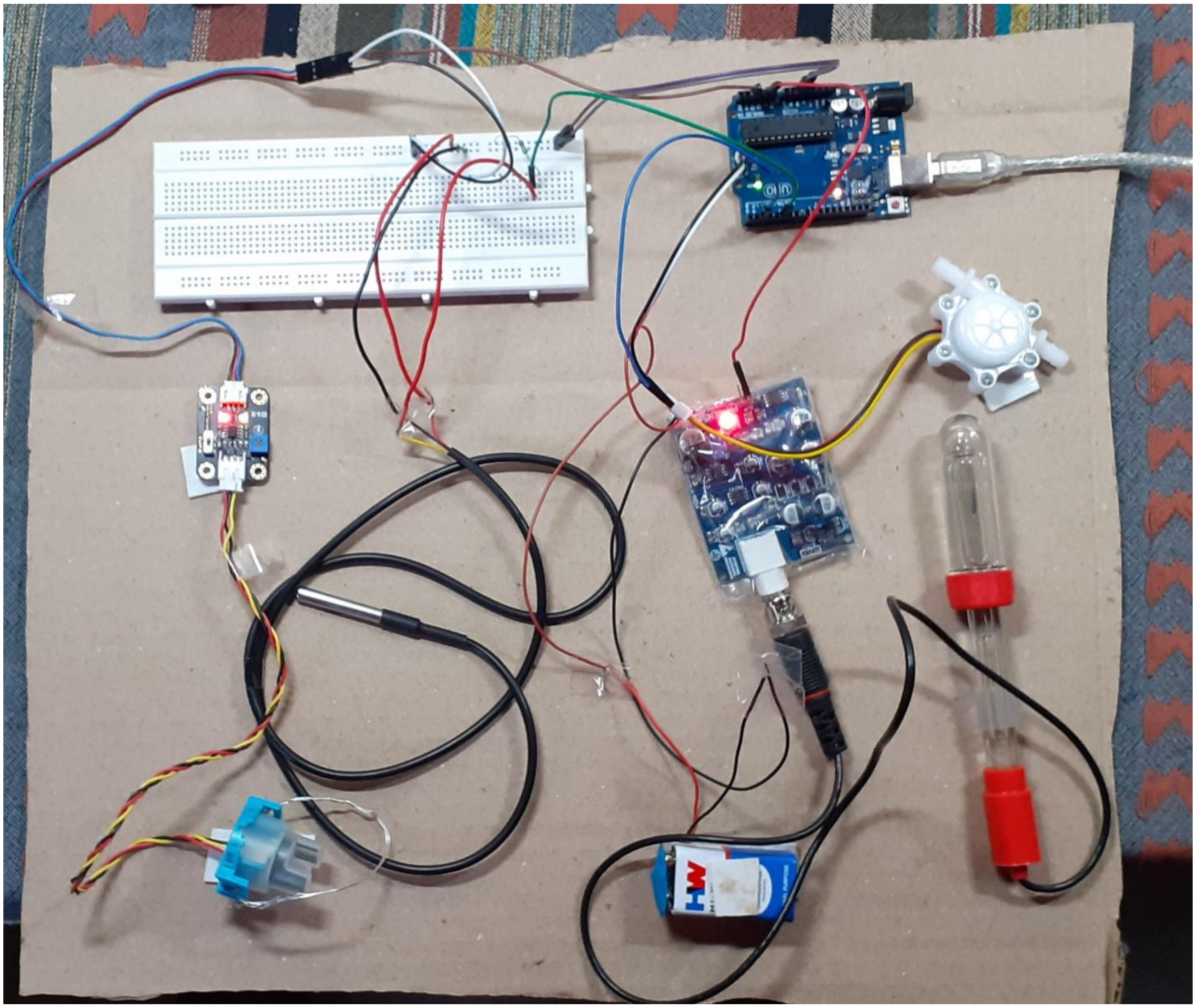

Figure 11

3.5.Design description

Design and components used

1. pH Sensor
2. Turbidity Sensor
3. Temperature Sensor
4. Flow Sensor
5. LED bulbs
6. Arduino Kit

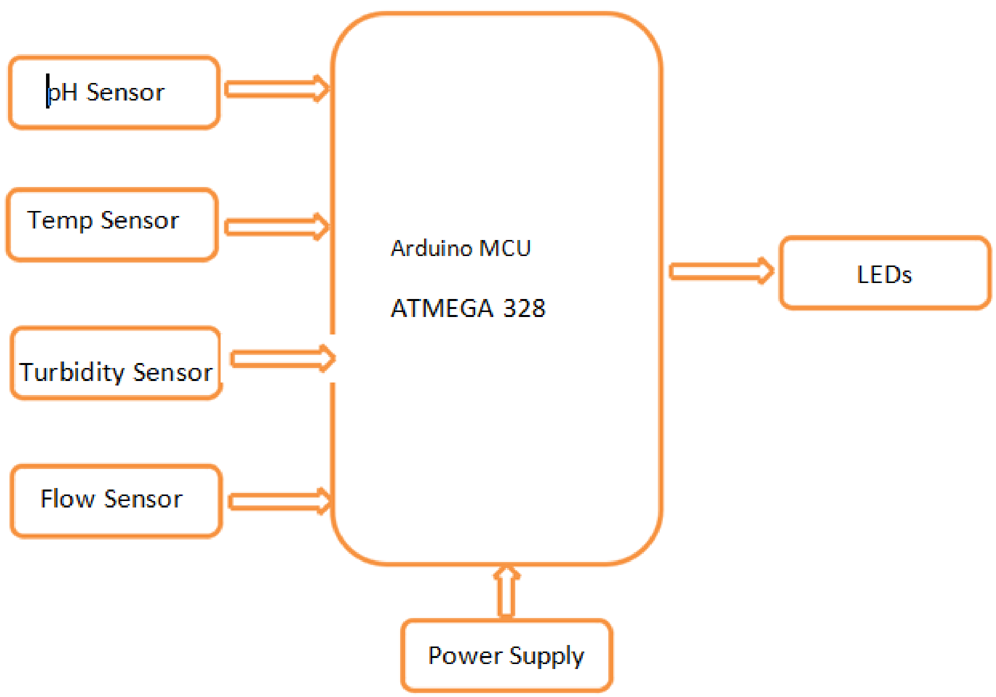

Figure 12

4. Implementation

4.1. Description of Modules/Programs

In this project we connected the above sensors together with the Arduino UNO. All the four sensors temperature, flow, turbidity and pH together with the help of bread board. The first three sensors had three different colored wires black, red and yellow. These wires are pre-defined as the black wire is connected to the GROUND, the red wire is connected to the POWER supply, here we choose 5V supply in the Arduino. The third wire was yellow in color is the data wire and is connected to data pin in the Arduino. The pH sensor had a slightly different connection because of the presence of two GND pins. The data pin of temperature was connected to digital pin 5, the data pin of flow to digital pin 2, that of the turbidity sensor to A0 and of the pH sensor to A1. We have also connected a red led to pin 12, an orange one to pin 11, green to 10 and a blue to 9 whose working is explained later in the report.

After setting up the connection we first checked whether all the sensors were working fine or not. The Arduino and analog to digital converter chip of turbidity sensor indicated through led blink present in the chips. We blew air through the flow sensor to check it and it was working fine, the pH sensor was also calibrated properly and on inserting temperature sensor in water we saw change as in decrease in temperature value.

The green LED was to indicate that the water was perfectly good to drink, orange indicates that the water is not fit for drinking but can be used for other household purposes and the red indicates that it is altogether not fit for use.

The blue LED is to indicate that the user has used a lot of water and is over and the tank is about to be empty.

For the safe range, pH should be between 6.5 to 8.5, turbidity output should be less than 4.2 and temperature should be between 20 – 30 degree Celsius.

A pH of 6 can be used for other purposes and a temperature less than 50 degree Celsius can also be used for purposes other than drinking.

4.2.Source Code

```
#include <OneWire.h>
#include <DallasTemperature.h>

#define ONE_WIRE_BUS 5

OneWire oneWire(ONE_WIRE_BUS);

DallasTemperature sensors(&oneWire);

byte statusLed          = 13;

byte   sensorInterrupt =        0;    // 0 = digital pin 2
byte   sensorPin          =      2;

//    The hall-effect flow sensor outputs approximately 4.5 pulses per second per
//    litre/minute of flow.
float calibrationFactor = 4.5;

volatile byte pulseCount;

float flowRate;
unsigned int flowMilliLitres;
unsigned long totalMilliLitres;

unsigned long oldTime;

float Celcius=0;
float Fahrenheit=0;
```

```
const int analogInPin = A1;
int sensorValue = 0;
unsigned long int avgValue;
float b;
int buf[10],temp;
void setup(void)
{

Serial.begin(9600);
sensors.begin();


//      Set    up    the    status    LED    line    as    an    output
pinMode(statusLed, OUTPUT);
   digitalWrite(statusLed, HIGH); // We have an active-low LED attached

pinMode(sensorPin, INPUT);
digitalWrite(sensorPin, HIGH);


pulseCount      flowRate     = 0;
flowMilliLitres              = 0.0;
totalMilliLitres oldTime     = 0;
                             = 0;
                             = 0;


//   The Hall-effect sensor is connected to pin 2 which uses interrupt
     0.
//   Configured to trigger on a FALLING state change (transition from
     HIGH
//   state to LOW state)
attachInterrupt(sensorInterrupt, pulseCounter, FALLING);
}
```

```
void loop(void)
{
int sensorValue = analogRead(A0);// read the input on analog pin 0:
   float voltage = sensorValue * (5.0 / 1024.0); // Convert the analog reading (which goes
from 0 - 1023) to a voltage (0 - 5V):
Serial.println(voltage); // print out the value you read:
delay(500);

sensors.requestTemperatures();
delay(1000);
Celcius=sensors.getTempCByIndex(0);
Fahrenheit=sensors.toFahrenheit(Celcius);
Serial.print(" \nC                    ");
Serial.print(Celcius);
Serial.print(" F                    ");
Serial.println(Fahrenheit);
Serial.print("\n");
delay(1000);

if((millis() - oldTime) > 1000)                             // Only process counters once
per second
{
    //    Disable the interrupt while calculating flow rate and sending the value to
//    the host
detachInterrupt(sensorInterrupt);

    //    Because this loop may not complete in exactly 1 second intervals we
calculate
    //    the number of milliseconds that have passed since the last execution and use
    //    that to scale the output. We also apply the calibrationFactor to scale the output
```

```
        //    based on the number of pulses per second per units of measure (litres/minute in
//    this case) coming from the sensor.
        flowRate = ((1000.0 / (millis() - oldTime)) * pulseCount) / calibrationFactor;

        //    Note the time this processing pass was executed. Note that because we've
        //    disabled interrupts the millis() function won't actually be incrementing right
        //    at this point, but it will still return the value it was set to just before
//    interrupts went away.
    oldTime = millis();

        //    Divide the flow rate in litres/minute by 60 to determine how many litres have
        //    passed through the sensor in this 1 second interval, then multiply by 1000 to
//    convert to millilitres.
    flowMilliLitres = (flowRate / 60) * 1000;

//    Add the millilitres passed in this second to the cumulative
    total
    totalMilliLitres += flowMilliLitres;

    unsigned int frac;

    //          Print the flow rate for this second in litres / minute Serial.print("Flow rate:
    ");
        Serial.print(int(flowRate)); // Print the integer part of the variable
    Serial.print("L/min");
    Serial.print("\t");                    // Print tab space
```

```
//      Print the cumulative total of litres flowed since starting Serial.print("Output
Liquid Quantity: "); Serial.print(totalMilliLitres);
Serial.println("mL");
Serial.print("\t");                    // Print tab space
Serial.print(totalMilliLitres/1000); Serial.print("L");
Serial.print("\n");

//      Reset the pulse counter so we can start incrementing again pulseCount = 0;

//   Enable the interrupt again now that we've finished sending
output
attachInterrupt(sensorInterrupt, pulseCounter, FALLING);
}

for(int i=0;i<10;i++)
{
buf[i]=analogRead(analogInPin);
delay(10);
}
for(int i=0;i<9;i++)
{
for(int j=i+1;j<10;j++)
{
if(buf[i]>buf[j])
{
temp=buf[i];
buf[i]=buf[j];
buf[j]=temp;
}
```

```
}
}
avgValue=0;
for(int i=2;i<8;i++)
avgValue+=buf[i];
float    pHVol=(float)avgValue*5.0/1024/6;    float
phValue = -5.70 * pHVol + 21.34; Serial.print("sensor
= "); Serial.println(phValue);

delay(20);

digitalWrite(10, LOW);
digitalWrite(11, LOW);
digitalWrite(12, LOW);
digitalWrite(9, LOW);

 if (phValue <= 8.5 && phValue >= 6.5){ if (voltage
<= 4.2){
if (Celcius >= 20 && Celcius <= 30){ digitalWrite(10,
HIGH);
}
else if (Celcius>= 15 && Celcius <= 50){ digitalWrite(11,
HIGH);
}
}
}
 else if (phValue >= 6 && phValue <= 6.5){ if (voltage <=
4.2){
if (Celcius>= 15 && Celcius <= 50){
digitalWrite(11, HIGH);
}
```

```
}
}
else{
digitalWrite(12, HIGH);
}

if (totalMilliLitres/1000 > 100){
digitalWrite(9, HIGH);
}
}

void pulseCounter()
{
// Increment the pulse counter
pulseCount++;
}
```

4.3. Execution snapshots

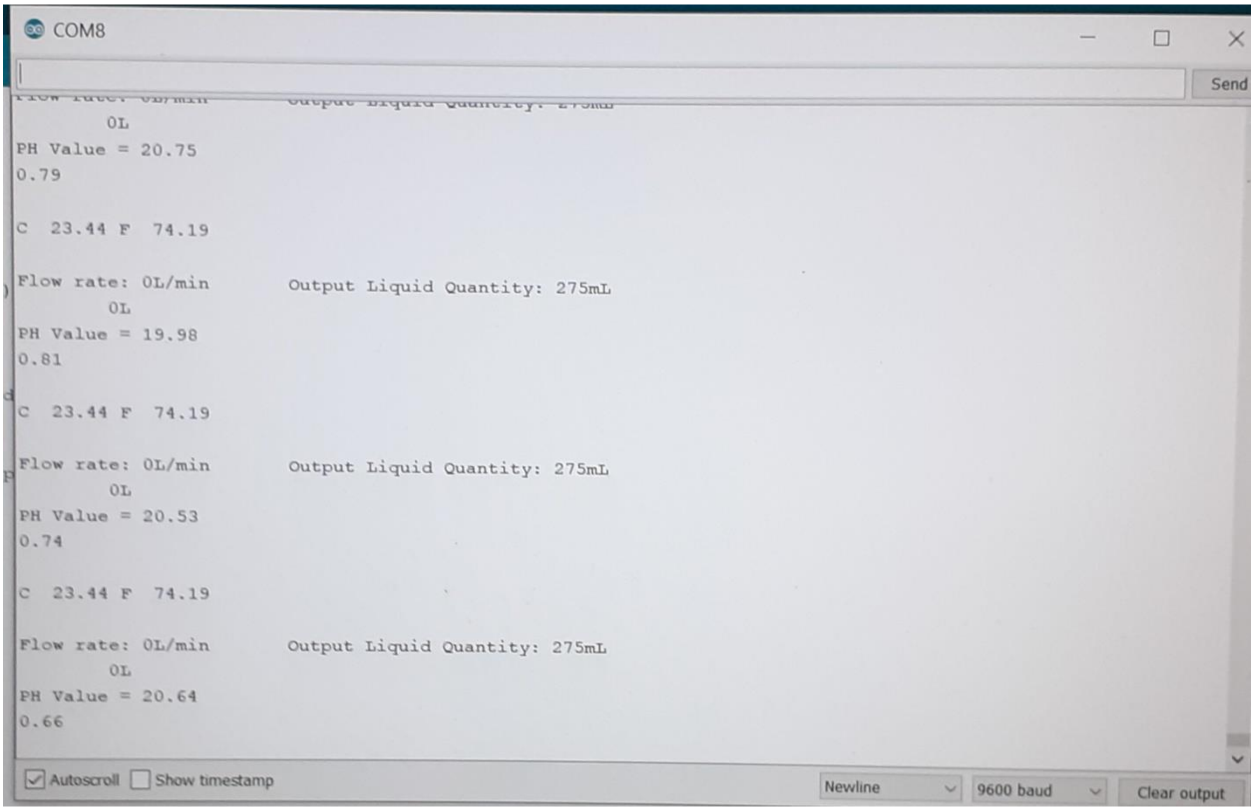

Figure 13

5. Conclusion and Future Directions

Using the values from Turbidity, Temperature, pH and Flow sensors we can determine the quality of water and provide the information to the user using this device. The process is completely automated and does not require the user to do any work making it very useful and fast process. The LEDs will alert the user stating that the water is contaminated along with a little information about the water level. Thus, the user can take the action he wishes to depending on the situation.

Right now, the system is for household use only but it can be developed for various other uses. This system can be used in industries, agriculture and for even house hold purposes. Different parameters might be important for different users depending upon their needs, Turbidity can alone verify the quality of water in terms of dissolved solids, while some industrial processes require water as a raw material in a certain range of temperature. On the other hand, information such as the rate of flow of water can be used in dams to determine the amount of electricity produced. Just by changing the threshold values we can choose the level of purity that the user requires and thus providing user with the suitable information.

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