Design for fishery water environment monitoring system based on IOT

Liu Shue[1,a]

[1]Binzhou Medical University, Yantai 264003, China

[a]lse32@163.com

Keywords:IOT, water environment, monitoring

Abstract. This paper designs such a fishery water environment monitoring system based on the technology of the internet of things, it can monitor the dissolved oxygen, temperature, turbidity and ionization degree etc in real time. It also analyzes and designs the turbidity sensor, dissolved oxygen sensor, and the selection and realization circuit design for the sensor related to pH, electrical conductivity, turbidity etc. Through the experiments in the Fenghuang Mount reservoir of Yantai and Luoxue Lake of Shandong Technology and Business University, the results shows that, this system can achieve the information of temperature, pH, turbidity and electrical conductivity from multiple waters in real time

Introduction

In recent years, along with the increasingly improved scale and integration degree of aquaculture and the increased breeding types and density, the quality and environment of cultured waters has become worse gradually with higher and higher incidence of disease. Thus it also resulted in the increasingly prominent quality safety issue of the aquatic products. Therefore a water quality and environment monitoring system for aquaculture is urgently needed to be created, so as to know the water quality of the living environment for the cultured fishes, and take the effective measure to regulate and control the water quality, guarantee the quality safety of aquatic products, achieve the target of safe.

System hardware design

Turbidity sensor

While the light passing through the water in certain volume, the permeation rate of light should depend on the turbidity of the water, the higher turbidity of the water, the less permeated light. The receiving end of light shall transfer the permeated light strength into the matching current, the more permeated light, the higher current value, on the contrary the less permeated light, the smaller current accordingly. Through detecting the current value on the receiving end, the water turbidity can be calculated accordingly. For the turbidity value is such a gradual variable, usually for the turbidity acquisition of the sensor under the dynamic environment, the external controller should be connected and installed for AD conversion, to convert the turbidity under the matching environment, it shall also be with the water-proof detector.

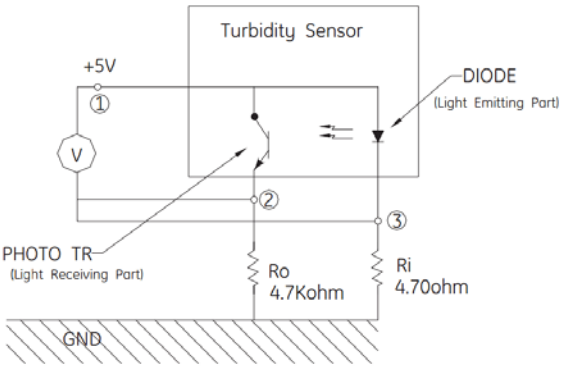

Fig.1 the circuit for turbidity detection

The calculating formula:

Turbidity_Voltage is the voltage value of acquired turbidity, zd is the turbidity value, with the unit as %.

If turbidity_Voltage>=1.15，turbidity is 0%；

If turbidity_Voltage<=0.20，turbidity is 100%；

If 0.20<turbidity_Voltage<1.15时，turbidity is equal to115-turbidity_Voltage*100；

the program implementation code is given below:

```
if(turbidity_Voltage>=1.15)
      zd=0;
    if(turbidity_Voltage<=0.20)
      zd=100;
    if(0.2<turbidity_Voltage<1.15)
      zd=(115-turbidity_Voltage*100);
```

Dissolved oxygen sensor

This digital dissolved oxygen sensor shall not need to connect with the display instrument with large volume, it can output 485 (digital signal) or 4-20ma (analog signal) or 0-5V (analog signal) or 0-3.3V (analog signal), and with convenience for development.

The calculating formula is as follows,

oxagy_Voltage is the voltage value of dissolved oxygen with AD acquisition,oxagy is the value of dissolved oxygen, with unit as mg.

While oxagy_Voltage>=0.95, the dissolved oxygen is 0mg；

While oxagy_Voltage<=0.50，the dissolved oxygen is 100mg；

While 0.250<oxagy_Voltage<0.95，the dissolvex oxygen = 100-(oxagy_Voltage-0.4)*166.666；

The program implementation code is given below:

```
oxagy_Voltage=(sum/20.0);
    if(oxagy_Voltage>=0.95)
      oxagy=0;
    if(oxagy_Voltage<=0.50)
      oxagy=100;
    if(0.50<oxagy_Voltage<0.95)
      oxagy=100-(oxagy_Voltage-0.4)*166.666;
```

PH

The pH value combination electrode shall output the voltage signal in mv level, and with quite higher internal resistance. So during the circuit design, the operational amplifier with ±5 V power supply is used to form the 3-grade circuit.

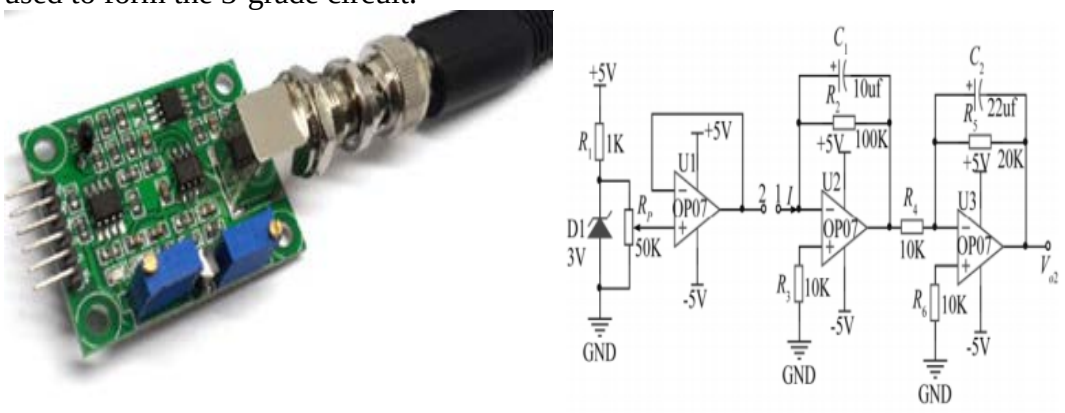

Fig.2 the detecting substance of pH value and circuit

The calculating formula is as follows,

PH_Voltage is the voltage value in three times of AD acquired pH voltage, pH is the pH value.

The program implementation code is given below:

```
PH_Voltage=(sum/20.0)*3;
    if(PH_Voltage>=3.347)
       ph=4.0;
    else if(PH_Voltage<=2.36)
       ph=10;
    else if(2.36<PH_Voltage<3.47)
       ph=(3.347-PH_Voltage)/0.14-1.4*(3.347-PH_Voltage)+4-0.7;
```

The electrical conductivity

The electrical conductivity shall be the ability of substance transmitting the current, it shall be the reciprocal of resistivity. For liquid, it usually uses the reciprocal of the resistivity- electrical conductivity to measure the conductive capacity. The unit of electrical conductivity is called as S/m, other units shall be S/m, mS/cm, μS/cm. Its conversion relation is that 1S/m=1000mS/m=1000000μS/m=10mS/cm=10000μS/cm. The electrical conductivity electrode shall output the current in mA level, so it may need to be amplified accordingly.

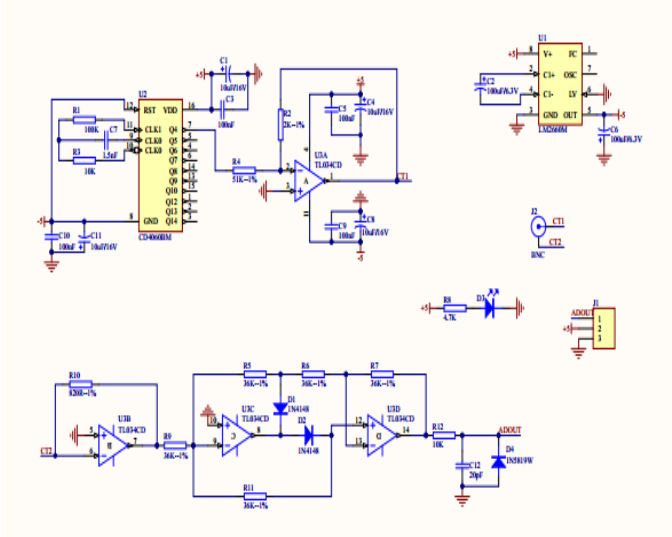

Fig.3 The circuit for electrical conductivity detection

The calculating formula is as follows,

elec_Voltage shall be the voltage value in three times of AD acquired electrical conductivity, the electrical conductivity is pH value.

While elec_Voltage<0.7，the electrical conductivity is (elec_Voltage-0.00)*11.137*2；

While elec_Voltage>0.7，the electrical conductivity is (elec_Voltage+0.03)*11.44*2；

The program implementation code is given below:

```
elec_Voltage=sum/20.0;
   if(elec_Voltage<0.7)
      ddl=(elec_Voltage-0.00)*11.137*2;
   else if(elec_Voltage>0.7)
      ddl=(elec_Voltage+0.03)*11.44*2;
```

Temperature sensor

The DS18B20 digital thermometer can provide the programmable device temperature reading in 9 to 12 digits. For DS18B20 has only one line communication, the central micro processor only has one line to connect with DS18B20 for reading/ writing and temperature conversion and it can get energy from the data line, do not need the external power supply.

The feedback of electrical conductivity and turbidity sensor are all the current values, so by adding the resistance to achieve the voltage between the two ends of resistance, the output pH and dissolved oxygen shall be voltage value, through partial pressure treatment to get the proper voltage, for the AD voltage detection range of cc3200 is around 0-1.4V, so as to use the appropriate resistance to maintain the voltage between the two ends of resistance around 0-1.4V, through matched

calculating formula to get the corresponding data detected by the sensor. DS18B20 is selected as the temperature sensor, it shall not need any circuit treatment to read the value. Its circuit is shown in following figure 4:

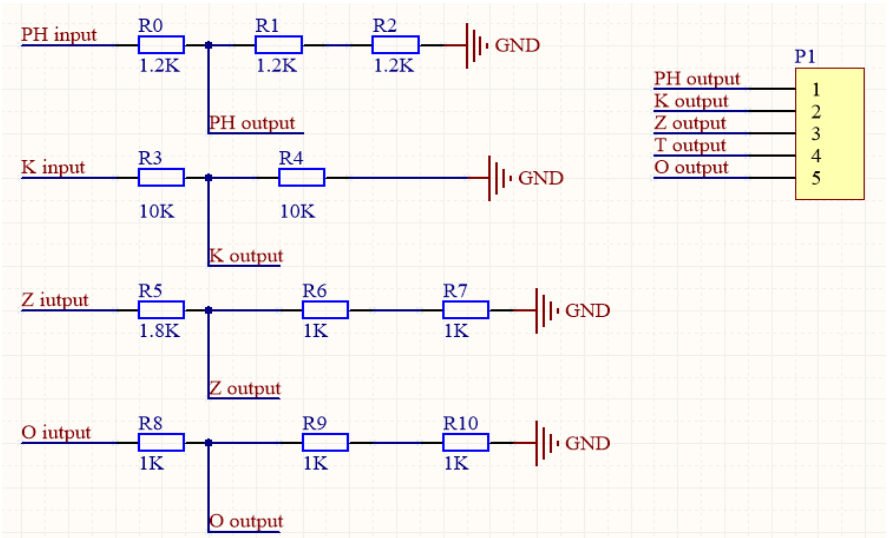

Fig.4 the circuit for temperature detection

Test

Later on this system is used for the test in the Fenghuang Mount reservoir of Yantai and Luoxue Lake of Shandong Technology and Business University, as per shown in figure 7. The system can acquire the temperature, pH, turbidity, dissolved oxygen rate and electrical conductivity information in real time and store them into database, through text form to download the data and make the data comparison. Through data comparison it can be found that, in a long time, through this water quality parameter multi-point monitoring and warning system, it can acquire the online temperature,pH, turbidity and electrical conductivity information from several waters in real time, under the overrun parameter index, it can also make the warning prompt and meet the system design requirements.

Acknowledgements

This work was financially supported by project development plan of science and technology of Binzhou Medical University(BY2014KJ09),National Natural Science Foundation (No.61070175), Shandong Province Natural Science Foundation(ZR2013FL017, ZR2013FL018), Shandong Province University Science and Technology(J12LJ03) of China, project development plan of science and technology of Yantai(2013ZH347,2013ZH091).

References

[1] Kaushik S.Nutrition and feeding of fish: upcoming developments [J].Cahiers Agriculture,2009，18(2):100-102.

[2] Huang Jianqing, Wang Weixing, Jiang Sheng, et al. Development and test of aquacultural water quality monitoring system based on wireless sensor network[J]. Transactions of the Chinese Society of Agricultural Engineering, 2013, 29(4): 183－190.

[3] Bu Shijie.Design of Aquacltural Environment Monitoring System Based on WSN[J].Journal of Gansu Sciences,2016,28(1):55-60

[4] Zhang Shiliang. Design of Fisheries intelligent aquaculture system based on IOT. Journal of Ningde Normal University (Natural Science),2015,27(3):299-303