ISSN:0975-9646

Bodepudi SrinivasaRao et al, / (IJCSIT) International Journal of Computer Science and Information Technologies, Vol. 3 (3) , 2012,4079-4083

Design an Monitoring System of Aquaculture with Multi-Environmental Factors Using ARM7

Bodepudi SrinivasaRao, U.Jyothi Kameswari
Department of ECM, K.L.University, Vijayawada, A.P., India

***Abstract*— The importance of water quality in Aquaculture and design an environmental factors monitoring system. The aim of the Paper is Design An Aquaculture Monitoring system and to monitor the analog parameters and transmit these values to the other side where they can be read and compared with the set points. If these values exceed their corresponding set points, the system displays the fault indication message on the LCD with Sound alarming. The Communicate uses ZigBee to implement this application. The analog parameters like PH, Temperature and Humidity are read by the respective sensors and these values are transmitted by the transmitter section. Here Transmitter section is Slave computer. The receiver section; host computer receives these values and passes the data to the controller section. The ARM controller compares these values with the fixed values and if they exceed the set points, the ARM controller displays the parameter, which actually exceeds its set point, on the LCD with Sound alarming.**

***Keywords*— Aquaculture, Real-Time monitoring, ARM, ZigBee, Micro computer.**

1. Introduction

Water quality will directly affect the growth of aquaculture objects which affects the production and economic benefits. In the promotion of health culture concept and environment-friendly aquaculture, it has greater demands on water quality management [1]. In the introduction a definition of monitoring suggested that monitoring was for compliance with regulatory standards for protection and safeguarding environmental quality. This is true and forms the basis for monitoring, but other reasons are also important. The aquaculture industry has an important "stakeholder" interest in environmental quality. As pointed out earlier water quality (in particular) is of essential importance in maintaining the health of the cultured resource. This is true whether the reason be for optimization of fish growth to legal liability in case of litigation due to unacceptable environmental change which affects other resource users Environmental monitoring is therefore an important part of fish farm management. The continuous and real-time automatic monitoring of water parameters will not only lead to a high quality aquaculture management but also provide accurate experimental data which help to optimize breeding **process reduce farming costs and improve breeding efficiency [2]. Therefore it is meaningful to establish monitoring system. PC and ARM7 controller system are used as the host computer and slave computer respectively of the whole system which has a function of automatically detecting environmental factors of temperature, PH and humidity. These analytically results can help to provide a suitable environment for aquatic products, the implementation of automatic feeding, science culture and other functions, safe, high quality, highyield purposes.**

2. Scope And Objective

The main Objective of this Paper is to Monitor the Multi-environmental factors Like Temperature, PH, Humidity Of respective sensors. that is it can convert the collected data and store it as digital signal. the system can achieve real-time monitoring, data collection, read, store and compared with the set points. If these values exceed their corresponding set points, the system displays the fault indication message on the LCD with sound alarming.

3. Hardware Description

This monitoring system consists of PC host computer, slave computer in which the ARM7 controller from ARM Company is used as the core and a ZigBee module to transfer data[6]. Figure-1 is the structure schematics of system. Slave computer can measure and control the environmental factors of breeding system, that is, it can convert the collected data and store it as digital signal. Output corresponding signals after comparing collected data with designed value which will be transferred to host computer by ZigBee module. The PC will used to settle the system, controll parameters, data processing, analysis and display.

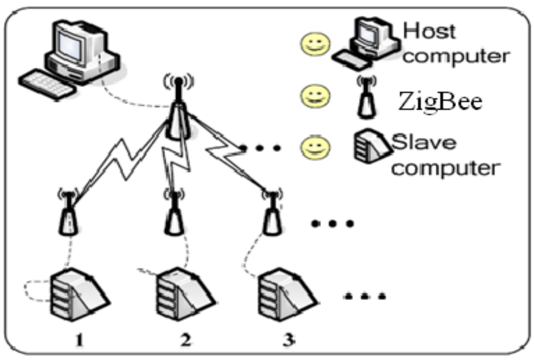

Figure-1: Structure of Environment Monitoring System

3.1. *Slave Computer*

It discusses design and working procedure of the system with the help of block diagram and explanation of circuit diagram in detail. it explains the features, timer programming, and serial communication, of ARM7 controller. It also explains the various modules used in this design [4].The slave computer can individually accomplish environment factors measurement, data analysis, display message on the LCD and transmit this values to the host Computer. In this case Slave Computer is a close-loop control system. Figure-2 is the Hardware diagram of slave computer system. It consistes of shown in Below.

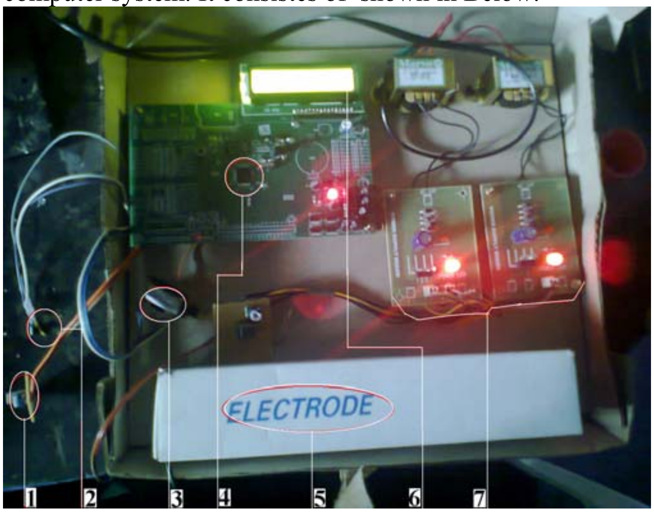

Figure-2: Hardware diagram of slave computer (ON mode); [1].Humidity Sensor; [2].Temp.Sensor;[3].ZigBee Module; [4].ARM7 controller; [5].PH meter; [6].LCD display unit; [7].Power supply unit.

3.2. *Host Computer*

It discusses design and working procedure of host computer with the help of block diagram. This is a Recevier section. In this case ZigBee Rx. receives these values and passes the data to the controller section[6&12]. The ARM controller compares these values with the fixed values and if they exceed the set points, the ARM controller displays the parameter, which actually exceeds its set point, on the LCD with Sound alarming. Figure-3 is the Hardware diagram of Host computer system. It consistes of shown in Below

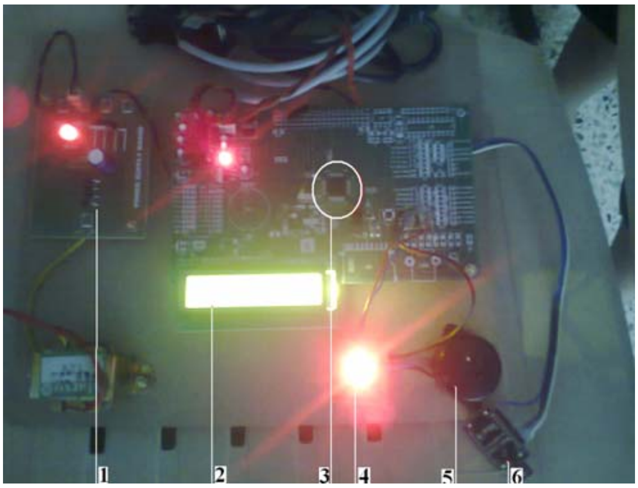

Figure-3: Hardware diagram of Host computer (ON mode); [1]. Power supply unit; [2]. LCD display unit; [3].ARM7 controller; [4]. Light indicator;[5].Buzzer; [6].ZigBee Module.

A. ***ARM 7:***

ARM is a 32-bit RISC processor architecture currently being developed by the ARM corporation. The business model behind ARM is based on licensing the ARM architecture to companies that want to manufacture ARM-basedCPU's or system-on-a-chip products. The Implementation license provides complete information required to design and manufacture integrated circuits containing an ARM processor core. ARM licenses two types of cores: soft cores and hard cores.A hard core is optimised for a specific manufacturing process, while a soft core can be used in any process but is less optimised. The architecture license enables the licensee to develop their own processors compliant with the ARM ISA. ARM processors possess a unique combination of features that makes ARM the most popular embedded architecture today. First, ARM cores are very simple compared to most other general-purpose processors, which means that they can be manufactured using a comparatively small number of transistors, leaving plenty of space on the chip for application-specific macrocells. A typical ARM chip can contain several peripheral controllers, a digital signal processor, and some amount of on-chip memory, along with an ARM core. Second, both ARM ISA and pipeline design are aimed at minimising energy consumption a critical requirement in mobile embedded systems. Third, the ARM architecture is highly modular: the only mandatory component of an ARM processor is the integer pipeline; all other components, including caches, MMU, floating point and other co-processors are optional, which gives a lot of flexibility in building application-specific ARM-based processors. Finally, while being small and low-power, ARM processors provide high performance for embedded applications[5].

Features are: 32-bit RISC-processor core (32-bit instructions);37 pieces of 32-bit integer registers (16 available);Pipelined(ARM7:3 stages); High Code density;Mostly Single-cycle execution;8 / 16 / 32 -bit data types;Speed 1Mhz to 1.25Ghz; simple structure, reasonably good speed and power consumption ratio.

B. ***Sensors Module*:**

① *GPP011 PH meter* to measure the value of PH which is a kind of immersion probe, type of GPE02P, has the precise of ±0.01pH, the range of output voltage is 0~5V, has a power of 2.5w.

② *Humidity sensor* is used to measure the humidity of air. It has a precise of 0.01mg/L, range of measurement is 0~20mg/L, the range of output voltage in air is 15~20mV, response time is less than 20s.

③ *LM35 Temperature sensor* is used to measure temperature. The input voltage is +15V. The high resistor current resource is changing with a speed of 1μA/℃ .

C. Wireless Communication Module:

The wireless communication module is used to transfer data between Slave computer and Host computer. because there are many problems in practice with wire communication such that increasing the complexity and the maintenance cost and reduce the flexibility of slave computer with wire communication [6&12]. The transparent data transmission is used by ZigBee, the users do not need to change the origin program and connecting. It can transfer a distance of 20 metre. This module has I2C and RS232. so that the time of data sending and receiving is staggered. The way of connection is bus connection between upper and lower computer under the premise of considering communication delay.

D. Power Supply Module:

The input to the circuit is applied from the regulated power supply. The a.c. input i.e., 230V from the mains supply is step down by the transformer to 12V and is fed to a rectifier. The output obtained from the rectifier is a pulsating d.c voltage. So in order to get a pure d.c voltage, the output voltage from the rectifier is fed to a filter to remove any a.c components present even after rectification. Now, this voltage is given to a voltage regulator to obtain a pure constant dc voltage.below fig-3 shows power supply module.

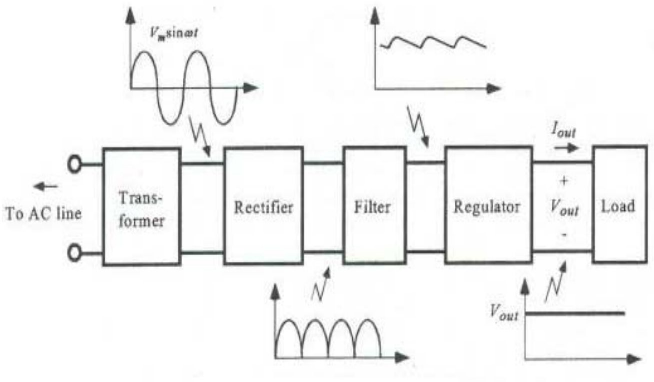

Figure-4: Components Of Regulated Power Supply

5. SOFTWARE DESCRIPTION

The software system consists of upper and lower computer software. the upper computer software is established by Embedded C. It has the function as following: creating the expert system of aquaculture, the expert system will provide suggestions and export controlling signals after analysing data from salve computer; transferring the maximum and minimum value of test access path of slave computer to itself; storing the data from slave computer to database; data compilation, analysis and curve displaying, etc. The Embedded C is used to create the slave computer software, and store it to RAM. Its main functions are getting the data and comparing it with the maximum and minimum value, and the result of comparison will used to control the output device according to the control arithmetic, and at last storing, displaying and uploading the data.

5.1. Software of Slave Computer and Host computer

Which includes data collecting module, data processing module, data displaying module, data storing module, data communication module and Light Alarming module.

5.2. Codeing for Sensors

```
/***PH  SENSOR***/
void main_delay(unsigned int val)
{    unsigned int main_i,main_j;
 for(main_i=0;main_i<val;main_i++)
  for(main_j=0;main_j<1000;main_j++);
}    int main()
{   unsigned int ad1,ad2,ad3;
 float ad;
 lcd_init();
 uart1_init();
 adc0_init();
 lcd_cmd(0x01);
 lcd_puts("ph   temp   hum ");
 while(1)
 {    uart1_putch('a');
  main_delay(2000);
  ad1=adc0_channel_1();
  lcd_cmd(0xc0);
  if(ad1>=0 && ad1<22)
  ad=7.0;
  if(ad1>22 && ad1<30)
  ad=7.5;
  if(ad1>30 && ad1<40)
  ad=8.0;
  if(ad1>40 && ad1<55)
  ad=8.5;
  if(ad1>55 && ad1<60)
  ad=6.0;
  if(ad1>60 && ad1<70)
  ad=5.0;
  if(ad1>70 && ad1<80)
  ad=4.0;
  if(ad1>80 && ad1<90)
  ad=3.0;
  if(ad1>90 && ad1<95)
  ad=2.0;
  lcd_float(ad);
  main_delay(200);
  uart1_float(ad);
  main_delay(2000);
  main_delay(2000);
 //uart1_putch('b');
 main_delay(2000);
  ad2=adc0_channel_2();
  lcd_cmd(0xc5);
  ad2=((ad2/2)-14);
  lcd_int(ad2);
  uart1_int(ad2);
  main_delay(2000);
  main_delay(2000);
  //uart1_putch('c');
  main_delay(2000);
  ad3=adc0_channel_3();
  lcd_cmd(0xcb);
  lcd_int(ad3);
  uart1_int(ad3);
  main_delay(2000);
 }
}
```

```
//***TEMP SENSOR***HUMIDITY SENSOR***//
void main_delay(unsigned int val)
{    unsigned int main_i,main_j;
 for(main_i=0;main_i<val;main_i++)
  for(main_j=0;main_j<1000;main_j++);
}  #define buzz  0x00000004
#define led   0x00000008
#define buzz_on  IOCLR0|=0x00000004
#define buzz_off IOSET0|=0x00000004
#define led_on  IOCLR0|=0x00000008
#define led_off IOSET0|=0x00000008
```

```
int main()
{  char ch;
 IODIR0 |=buzz;
 IODIR0 |=led;
 buzz_off;
 led_off;
 //buzz_on;
   //led_on;
 lcd_init();
 uart1_init();
 uart0_init();
 lcd_cmd(0x01);
 lcd_puts("ph   temp   hum ");
 uart0_puts("ph   temp   hum ");
 uart0_putch(10);
 uart0_putch(13);
 while(1)
 {     ch=uart1_getch();
  if(ch=='a')
  {
   lcd_cmd(0xc0);
   ch=uart1_getch();
   lcd_data(ch);
   uart0_putch(ch);
   ch=uart1_getch();
   lcd_data(ch);
   uart0_putch(ch);
   ch=uart1_getch();
   lcd_data(ch);
   uart0_putch(ch);
  //}
 // ch=uart1_getch();
   //if(ch=='b')
  //{    lcd_cmd(0xc5);
   uart0_putch(' ');
   uart0_putch(' ');
   ch=uart1_getch();
   lcd_data(ch);
   uart0_putch(ch);
   ch=uart1_getch();
   if(ch>'1')
   {    buzz_on;
    led_on;
   }   lcd_data(ch);
   uart0_putch(ch);
   ch=uart1_getch();
   if(ch>'5')
   {
    buzz_on;
    led_on;
   }   if(ch<'5')
   {
     buzz_off;
      led_off;
   }
   lcd_data(ch);
   uart0_putch(ch);
   ch=uart1_getch();
   lcd_data(ch);
   uart0_putch(ch);
  //}
  ///ch=uart1_getch();
  //if(ch=='c')
  //{
   lcd_cmd(0xcb);
   uart0_putch(' ');
   uart0_putch(' ');
   ch=uart1_getch();
   lcd_data(ch);
   uart0_putch(ch);
   ch=uart1_getch();
   lcd_data(ch);
   uart0_putch(ch);
   ch=uart1_getch();
   lcd_data(ch);
   uart0_putch(ch);
   ch=uart1_getch();
   lcd_data(ch);
   uart0_putch(ch);
   uart0_putch(10);
   uart0_putch(13);
  }
 }
}
```

5.3. Results And History Data:

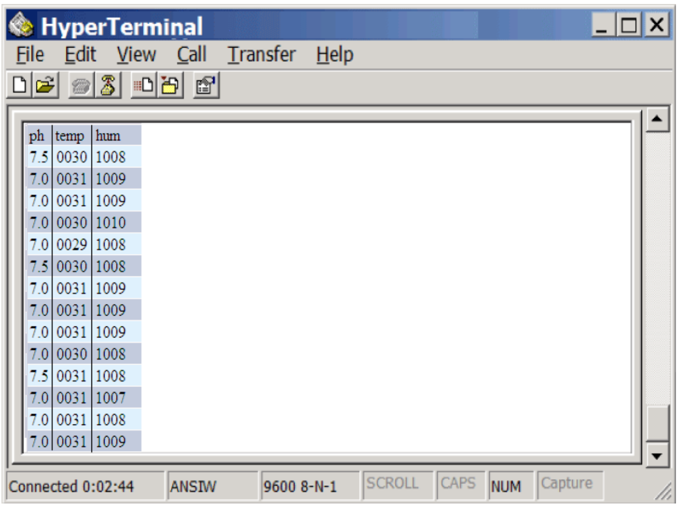

Figure-5: shows the results and history data

6. CONCLUSION

This system can control the real-time aquaculture environment factors and over problem has been raising to play automatic sound alarming with different set points. it can accomplish:

(1)Product Safe in automatic controller system to give safe mode in each time

(2) Energy saving Achieved by reducing the working time of oxygen pump through controlling the amount of dissolving oxygen.

(3) Increase output Make sure the aquatic products living with comfortable environment in order to reduce disease and reduce the usage of feed.

(4) Lower the labour intensity and improve efficiency.

ACKNOWLEDGEMENT

The authors are grateful Mr. G. Kalyan Mohan, Associate professor (KLU) for his encouragement and guidance to present/publish this paper. We acknowledge the diligent efforts of our Head of the Department Dr.S.Balaji in assisting us towards implementation of this idea.

REFERENCES

[1]. SONG Chang-tai. Water Quality Management Knowledge of Health Culture.Feed Research, vol.1, pp.57~60.2005

[2]. ZHOU De-qiang,YANG Long-xing. Research on Automatic Control System of Environmental Factors in Aquaculture. Journal of Jiangsu Teachers University of Technology, vol.12(4), pp.34~37, 2006.

[3]. Vertical integration as an alternative governance structure of value chain quality management: The case of Pangasius industry in the Mekong River Delta, Vietnam-0CT-2007

[4]. Steve Furber. ARM System-on-Chip Architecture. Addison-Wesley, 2nd edition;2010.

[5]. David Seal. ARM Architecture Reference Manual. Addison-Wesley, 2nd edition;2010.

[6]. IEEE 802.15.4 Wireless LAN Medium Access Control (MAC) and Physical Layer (PHY) specifications for Low-Rate

[7]. Thomas M. Losordo,Raul H. Piedrahita & James M. Ebeling An Automated Water Quality Data Acquisition System for use in Aquaculture Ponds Aquacultural Engineering 7 (1988) 265-278

[8]. D.D. Harris,Feng Zhang,P.H.Sydenham;Application of an exprt system to monitoring and control in Aquaculture, *Volume 4, Issue 3, September 1991,Pages 165-171*

[9]. YIAN Dong, FU Ze-tian, LI Dao-liang, etc. Design on the Freshwater Shrimp Culture Expert System Based-on Web. Application Research of Computers, vol.6, pp.24~25, 2001.

[10]. Beveridge, M.C.M. (1996). *Cage Aquaculture,* 2nd edn. Fishing News Books, Oxford

[11]. Tiago Alves and Don Felton. TrustZone: integrated hardware and software security. ARM whitepaper, 2009.

[12]. www.zigbee.org Zigbee-Alliance, "ZigBee specification,"

[13]. http://www.alldatasheet.com

[14]. http://www.mathworks.com

[15]. http://www.national.com/ds/LM/LM35.pdf

[16]. http://www.nxp.com/documents/user_manual/UM10139.pdf

WEB SITES

[1]. www.was.org/
[2]. www.electronicsforu.com/
[3]. www.arm.com/
[4]. www.zigbee.org/
[5]. www.ti.com/zigbee
[6]. www.embedded-code.com/

BIOGRAPHIES

Bodepudi SrinivasaRao: He born in Nuzendla,Andhra Pradesh,India.He is pursuing M.Tech in Embedded System in K.L.University,India. He received B.Tech degree in Electrical &Communication Engineering from Acharya Nagarjuna University-Guntur. His area of interest in Embedded Systems, Research interests include H/w analysis and RFID Technologies.

U.Jyothi Kameswari: she born in vijayawada,Andhra Pradesh, India. She is Pursuing Ph.D in k.L.University. She received M.Tech from Acharya Nagarjuna University. Her area of interest in Software Engineering.