MEASUREMENT AND ANALYSIS OF WATER QUALITY USING GSM

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ABSTRACT

With the rapid development of the economy, more and more serious problems arises in the environment, water pollution is one among them. The traditional method of water quality testing is to collect the samples manually and then send them to laboratory for analysis. However, it has been unable to meet the demands of water quality monitoring today. Measurement and analysis of water quality has been developed, in this system various parameters of water quality are automatically detected under the control of single chip PIC microcontroller throughout the day. Single chip gets the data, then processed and analyzes them. Then the data are instantaneously sent to the monitoring center by GSM. The abnormality in the water quality is reported to the monitoring center and management mobile to take the corresponding measures immediately.

Keywords -- PIC, Samples , Monitoring centre, GSM

I. INTRODUCTION

In many developing countries the bulk of domestic and industrial wastewater is discharged without any treatment or after primary treatment only. To care our environment and thus by our health we should keep our water clean. Domestic water treatment removes physical, chemical and biological contaminants from wastewater. Marine water bodies or areas where the discharge of wastewater does not adversely affect the environment as a result of morphology, hydrology or specific hydraulic conditions which exist in that area. Routinely monitored parameters of water quality are temperature, pH, turbidity, conductivity, dissolved oxygen (DO), chemical oxygen demand (COD), biochemical oxygen demand (BOD), ammonia nitrogen, nitrate, nitrite, phosphate, various metal ions and so on. The most common method to detect these parameters is to collect samples manually and then send them to laboratory for detecting and analysing. This method wastes too much manpower and material resource, and has the limitations of the samples collecting, long-time analysing, the aging of experiment equipment and other issues. Sensor is an ideal detecting device to solve these problems. It can convert non-power information into electrical signals. It can easily transfer, process, transform and control signals, and has many special advantages such as good selectivity, high sensitivity, fast response speed and so on. According to these characteristics and advantages of sensors, automatic measurement and reporting system of water quality is designed and developed. It bases on SMS (Short Messaging Service) in the GSM (Global System for Mobile Communications) network to instantaneously transfer the collected data. It also can remotely monitor the water quality on line. The system implements automation, intelligence and network of water quality monitoring, uses manpower, material and financial resources sparingly.

II. SYSTEM DESIGN

An efficient architecture for measurement and analysis water quality based on GSM contains two main units, they are industry unit, control unit.

2.1. Industry Unit

The architecture diagram for industry unit is shown in fig1. The system consists of multiple sensors of water quality testing, single-chip microcontroller data acquisition module, information transmission module, monitoring center and other accessories. Various parameters of water quality are automatically detected under the control of single chip microcontroller all day. The single chip gets the data, and then processes and analyzes them. In our system each and every individual water meter is been grouped by an individual network called **CONTROLLER AREA NETWORK** (CAN) Bus. It is a two wire serial communication protocol in which N number of nodes can be connected to form a network. In this system it will calculate the amount of water consumed by the industries in that locality separately and inform the water supplying system.

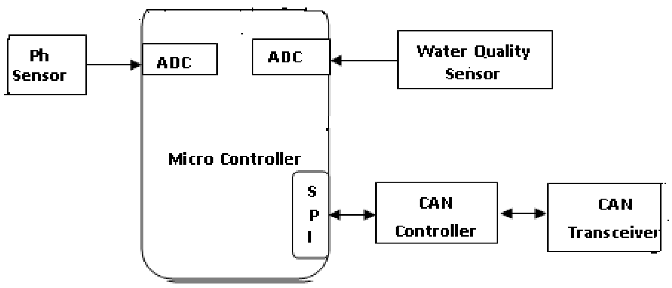


Figure 1.architecture of industry unit.

2.2. Control Unit

The conceptual architecture of the control unit is shown in fig 2. After that, the data are instantaneously sent to monitoring center by GSM network in the form of SMS. If the water quality is abnormal, the data will be sent to monitoring center and management's mobile in the same way at the same time. It is convenient for management to take corresponding measures timely and be able to detect real-time situation of water quality remotely. The system has realized the automation of water quality monitoring, intelligence of data analyzing and networking of information transferring. It is characterized by advantages of shortcut, accuracy and using manpower and material resources sparingly. The system has widespread application value and can be extended and transplanted to other fields of automatic monitoring where needed.

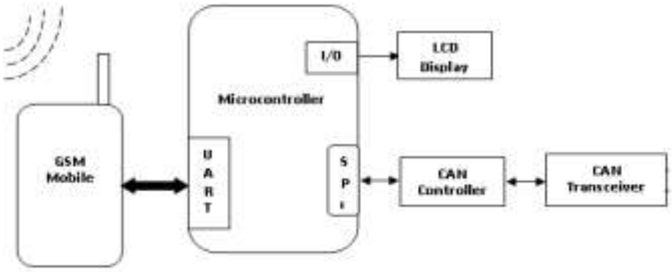


Figure 2.architecture of control unit.

III. SYSTEM COMPONENTS AND DESCRIPTION

3.1. Microcontroller

The microcontroller used in the proposed system is the PIC microcontroller (PIC 18F4480).

3.1. 1 LPC Board

In the field of microcontrollers, had their beginnings in the development of technology of integrated circuits. This development has made it possible to store hundreds of thousands of transistors into one chip. That was a prerequisite for production of microprocessors, and the first computers were made by adding external peripherals such as memory, input-output lines, timers and other. Further increasing of the volume of the package resulted in creation of integrated circuits. These integrated circuits contained both processor and peripherals. The figure 3. shows the overall hardware,

3.2. On-Chip Flash Memory System

The LPC2141/2/4/6/8 incorporate a 32 kB, 64 kB, 128 kB, 256 kB, and 512 kB Flash memory system, respectively. This memory may be used for both code and data storage. Programming of the Flash memory may be accomplished in several ways: over the serial built-in JTAG interface, using In System Programming (ISP) and UART0, or by means of In Application Programming (IAP) capabilities. The application program, using the IAP functions, may also erase and/or program the Flash while the application is running, allowing a great degree of flexibility for data storage field firmware upgrades, etc. When the LPC2141/2/4/6/8 on-chip bootloader is used, 32 kB, 64 kB, 128 kB, 256 kB, add 500 kB of Flash memory is available for user code. The LPC2141/2/4/6/8 Flash memory provides minimum of 100,000 erase/write cycles and 20 years of data-retention

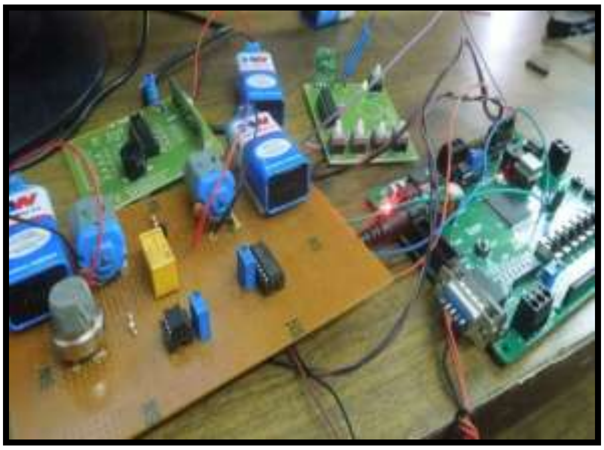


Figure 3. overall hardware

3.3. On-Chip Static RAM (SRAM)

On-chip Static RAM (SRAM) may be used for code and/or data storage. The on-chip SRAM may be accessed as 8-bits, 16-bits, and 32-bits. The LPC2141/2/4/6/8 provide 8/16/32 kB of static RAM, respectively. The LPC2141/2/4/6/8 SRAM is designed to be accessed as a byte-addressed memory.

3.4. USART

The Universal Synchronous Asynchronous Receiver Transmitter (USART) module is one of the two serial I/O modules. (USART is also known as a Serial Communications Interface or SCI). The USART can be configured in the following modes:

• Asynchronous (full duplex)

• Synchronous – Master (half duplex)

• Synchronous – Slave (half duplex)

In this mode, the USART uses standard non-return-to zero (NRZ) format (one start bit, eight or nine data bits, and one stop bit). The most common data format is 8 bits An on-chip, dedicated, 8-bit baud rate generator can be used to derive standard baud rate frequencies from the oscillator. The USART transmits and receives the LSB first. The USART's transmitter and receiver are functionally independent, but use the same data format and baud rate. The baud rate generator produces a clock either x16 or x64 of the bit shift rate, depending on bit BRGH (TXSTA<2>). Parity is not supported by the hardware, but can be implemented in software (and stored as the ninth data bit). Asynchronous mode is stopped during SLEEP. Asynchronous mode is selected by clearing bit

SYNC (TXSTA<4>). The USART Asynchronous module consists of the following important elements:

- Baud Rate Generator
- Sampling Circuit
- Asynchronous Transmitter
- Asynchronous Receiver

3.5. Sensors

Water detection sensors determine the system accuracy and cost. Generally, they are very expensive on the market. In order to reduce the cost, we choose DS18B20, make conductivity sensors, turbidity sensors and pH sensors by ourselves, and purchase dissolved oxygen sensor of U.S. Global Water .

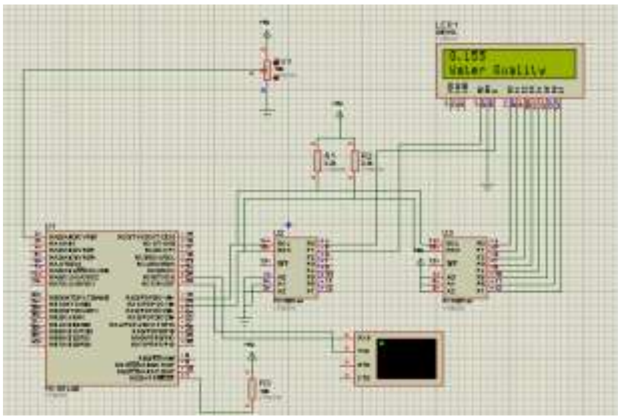
Temperature is one of the five common water quality parameters. Thermoelectric power temperature sensors and heat resistance temperature sensor are commonly used to detect water temperature. But thermoelectric power temperature sensors require temperature compensation, and the output of the heat resistance temperature sensor is not conducive to signal testing DS18B20 is produced by U.S. DALLAS Semiconductor Company. It is a digital temperature sensor, using single-bus protocol. The testing temperature range is -55 ° C-+125 ° C, and the accuracy between -10 ° C~+85 ° C is ± 0.5 °. Therefore, the DS18B20 temperature sensor is chosen.

Conductivity sensors are generally divided into two types: two electrodes or multiple electrodes. Conductivity of two electrodes is commonly used interiorly. Generally, two conductivity electrodes in laboratory can be made by using two platinized platinum to sinter on two parallel glass, or inner wall of the round glass tube. Changing the size of platinum pieces and adjusting the distance between them can make different constant value of two conductivity electrodes.

Turbidity is caused by suspended particles in water. Suspended particles block a lot of incident light and scattered light. It also diffuses the incident light. Therefore, photo electricity sensor is used to detect turbidity.

pH value is tested by the method of electric potential. Primary cell made by a constant potential reference electrode and measuring electrode is used in the method. A pH glass probe, which is sensitive to pH, is on measurement electrode. It is made of a special glass that can conduct electricity and permeate hydrogen ion. The potential can be produced when the glass probe touch the hydrogen ion. Different pH in the water generates corresponding potential. It can be converted into 4~20mA output by the transmitter. The amount of dissolved oxygen in water is a very important indicator of the water quality. The system uses WQ401 dissolved oxygen sensor produced by the U.S. Global Water Company. It is three-electrode structure and three-wire configuration. If the electrolyte deteriorates, the sensor can diagnose itself. Temperature compensation of it can reach to 25 ° C; the output is 4-20mA; testing range is 0-8ppm; accuracy is ± 0.5% of full scale; operating temperature is -40 ° C-+55 ° C. It is removable, and easy to maintain.

IV. EXPERIMENTAL RESULTS



Experimental results reveals that the detection of water quality is done through various types of water detection sensors, initially the water quality level is below 8. Using potentiometer the water quality level is increased when the water quality level is above 8 means the alert message that is “ph > 8 water is contaminated check the quality” sent to the monitoring center and management mobile through GSM. When the alert message is re-ceived to the monitoring center and management mobile means it takes corresponding measures immediately.

VIRTUAL TERMINAL
PH > 8 water is contaminated check the quality PH > 8 water is contaminated check the quality PH > 8 water is contaminated check the quality PH > 8 water is contaminated check the quality PH > 8 water is contaminated check the quality

Measurement and analysis of water quality is designed using proteus software, where the PIC microcontroller is connected to sensors at the port 1 and port 8. sensors helps to detect water quality level. The industry unit is placed at the industry, the number of nodes are connected to each other to form a network. The control unit is present in the monitoring center of the water quality.

V. CONCLUSION

An efficient architecture for measurement and analysis of water quality based on GSM is proposed and implemented using PIC 18F4480 microcontroller and GSM technology .The use of different water detection sensors helps to calculate the water quality of the system. The industry unit and control unit is designed and simulated using MPLAB IDE. In this the maximum water quality level is 8 once it crosses that level means it sent the message to monitoring centre using GSM. The implementation of water quality is automatically detected using various water detection sensors. Such as temperature, turbidity, conductivity and ph sensors are used to detect the water quality level.

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