# Automatic Measurement and Reporting System of Water Quality Based on GSM

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*Abstract:* **Water quality is one of the key threat for green globalization .Due to increase the economic development of Indian we can see the resulting speeding up the contamination and damage .peoples also responsible who throw garbage material in water, due to this water quality will be damaged.**

**The conventional technique of measuring the quality of water is to gather the samples manually and send it to laboratory for analysis ,but it has unable to meet demand of water quality today.It is not feasible to take water sample manually for laboratory after every hour for measuring and monitoring water quality.**

**So this paper proposes automatic measurement and reporting system of water quality .The set up consist of PIC microcontroller, water quality sensors, base station ,monitoring center and other system. The parameter involved in the water quality determination such as the PH level, DO, Turbidity and Temperature .**

**The water quality system can measuring the required qualities of water in real time .Firstly the total data can  send to PIc Microcontroller and process and analyze them.After that the data are sent to monitoring center by GSM in the form of SMS.If water quality is abnormal the data will be sent to monitoring center and management mobile simultaneously at  same time .The  system  has  realized ,  intelligence  of  data  analyzing  and  networking  of information transferring.**

*Keywords:* **Sensors; SMS; Remote Water quantity management; Turbidity; PH; Temperature.**

## 1.  INTRODUCTION

Water quality may be an advanced term to explore. The standard of water depends on such a lot of things. We've used many thought parameters in conjunction with one another to work out the water's quality. These include: pH, turbidity, conductivity, total dissolved solid and temperature. Since the standard technique of water quality measuring isn't economical thus there was a necessity to develop a system which is able to measure the standard of water in real time and also the system must be economical, correct and low price. The water quality measuring system makes use of multiple sensors, information acquisition module and data transmission module. Information acquisition module includes microcontroller 8051. Data transmission module includes GSM module. There are numerous sensors that measures temperature, turbidity, pH, conductivity and total dissolved solid present in the water. This technique conjointly uses ADC. The measured values are then transmitted to the watching centre via GSM; it's conjointly shown on LCD by the microcontroller. The system has the advantage of potency, accuracy and low price.

A Wireless sensor network (WSN) consists of spatially distributed autonomous sensor to monitor physical or environmental conditions, such as temperature, sound, vibration, pressure, motion or pollutants and to a main location The more modern networks are bi-directional, also enabling control of sensor activity Water pollution occurs when pollutants are discharged directly or indirectly into water bodies without adequate treatment to remove harmful compounds. Water pollution affects plants and organisms living in these bodies of water. In almost all cases the effect is damaging not only to individual species and populations, but also to the natural communities. Water covers over 70% of the earth's surface

and is a very important resource for people and the environment. Water pollution affects drinking water, rivers, lakes and oceans all over the world. This consequently harms human health and the natural environment. Here you can find out more about water pollution and what you can do to prevent it.

The most common method to detect these parameters is to collect samples manually and then send them to laboratory for detecting and analyzing. This method wastes too much manpower and material resource, and has the limitations of the samples collecting, long-time analyzing, 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, It bases on SMS (Short Messaging Service) in the GSM (Global System for

Mobile Communications) network to instantaneously transfer the collected data.

Sensor is an ideal detecting device to solve these problems. It can convert no 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, and fast response speed.

## 2.    SYSTEM HARDWARE ARCHITECTURE

**Overall Design of the System:**

The sensors being used are temperature sensor DS18B20 pH sensor, electrical conductivity sensor and a water flow sensor.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 °. A pH probe with pH ranging from 0-14 (Na+ error at >12.3 pH),speed of response being 95% in 1 second and is potential point being pH 7.00 (0 mV) with +/- 0.20 pH and 38400 baud rate default. A conductivity electrode with measuring surface as Platinum coating with max temperature 0-70° C. Data output is a comma separated string μs, TDS, Salinity. Water As shown in the diagram the system consists of various water quality measuring sensors such as pH, turbidity, conductivity and temperature, ADC, microcontroller 8051, GSM module and LCD. The water quality measurement system uses pH, turbidity, conductivity and temperature sensor to measure the quality of water. This sensor then measures the corresponding values of the water. Since the outputs of the sensors are analog in nature and microcontroller can handle only digital signals hence there is a need of a device which converts analog signals into digital signals. The system makes use of ADC for this purpose. Since the output of the sensors which are analog in nature are given to ADC, which converts the analog signals into the corresponding digital signals.

## 3.    TURBIDITY SENSOR

Turbidity is a measure of the cloudiness of water. Cloudiness is caused by suspended solids (mainly soil particles) and plankton (microscopic plants and animals) that are suspended in the water column. Moderately low levels of turbidity may indicate a healthy, well-functioning ecosystem, with moderate amounts of plankton present to fuel the fuel the food chain. However, higher levels of turbidity pose several problems for stream systems. 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. The most widely used measurement unit for turbidity is the FTU (Formazin Turbidity Unit).ISO refers to its units as FNU (Formazin Nephelometric Units).

There are several practical ways of checking water quality, the most direct being some measure of attenuation (that is, reduction in strength) of light as it passes through a sample column of water. The alternatively used Jackson Candle method (units: Jackson Turbidity Unit or **JTU**) is essentially the inverse measure of the length of a column of water needed to completely obscure a candle flame viewed through it. The more water needed (the longer the water column), the clearer the water. Of course water alone produces some attenuation, and any substances dissolved in the water that produce color can attenuate some wavelengths. Modern instruments do not use candles, but this approach of attenuation of a light beam through a column of water should be calibrated and reported in JTUs.
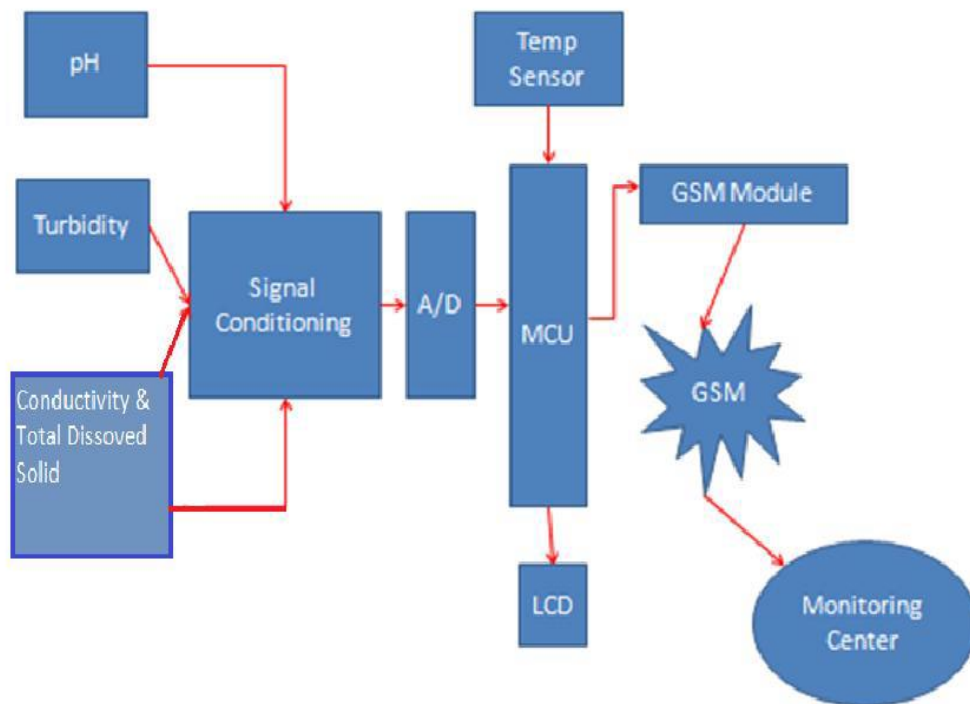
**PH sensors:**

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.

PH is an important limiting chemical factor for aquatic life. If the water in a stream is too acidic or basic, the H+ or OH- ion activity may disrupt aquatic organisms biochemical reactions by either harming or killing the stream organisms. pH is expressed in a scale with ranges from 1 to 14. A solution with a pH less than 7 has more H+ activity than OH-, and is considered acidic. A solution with a pH value greater than 7 has more OH- activity than H+, and is considered basic. The pH scale is logarithmic, meaning that as you go up and down the scale, the values change in factors of ten. A one-point pH change indicates the strength of the acid or base has increased or decreased tenfold. Streams generally have a pH values ranging between 6 and 9, depending upon the presence of dissolved substances that come from bedrock, soils and other materials in the watershed.

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. A pH measurement loop is essentially a battery where the positive terminal is the measuring electrode and the negative terminal is the reference electrode. The measuring electrode, which is sensitive to the hydrogen ion, develops a potential (voltage) directly related to the hydrogen ion concentration of the solution. The reference electrode provides a stable potential against which the measuring electrode can be compared.

**Conductivity:**

It defines the ability of the water to conduct electricity. As we know pure water has poor conductivity hence for water to be pure its ability to conduct electric current must be poor. 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.

**Temperature:**

It has an important influence on water. The system uses LM35 to measure the temperature of water. LM35 is a high precision temperature sensor.  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

## 4.   INFORMATION TRANSMISSION MODULE



Information transmission module is a GSM module. GSM module uses SIMENS TC35.A GSM module mainly consists of GSM baseband processor, GSM RF, power, Flash, antennas and antenna jack. The module provides standard AT command interface for users, and its working voltage is between 3.3V and 5.5V and power consumption is lower. What is more, it can transfer data and voice safely and fast at frequency bandwidth of 900MHZ and 1800MHZ. There are three SMS modes that the GSM supports: Block Mode□Text Mode and PDU Mode. The Text Mode sustains numbers and characters. The system mainly transmits the digital messages, so Text Mode is chosen to be applied. GSM module uses standard AT commands, and communicates with the signal chip by UART.

This module can accept any GSM network operator SIM card. Advantage of using this module is that we can use RS232 port to communicate. This GSM modem is highly flexible plug and play quad band GSM modem for direct and easy integration to RS232 applications. GSM module uses standard AT commands. Some of the AT commands are given below:- Command

Table 1     Common AT Commands menu

| Instructions | Function |
|---|---|
| AT+CIMI | Detect SIM card |
| AT+CREG | Detect network registration information |
| AT+IPR | Set baud rate |
| AT+CMGF | Set SMS mode |
| AT+CSMP | Set text mode parameters |
| AT+CSCS | Set characters |
| AT+CSCA | SMS service center address |
| AT+CMGS | Send message |
| AT+CMGR | Read SMS |
| AT+CNMA | News confirmed |
| AT+CMGD | Delete one or more SMS |

**System Software PIC 16F84A:**

High Performance RISC CPU Features:

• Only 35 single word instructions to learn

• All instructions single-cycle except for program branches which are two-cycle

• Operating speed: DC - 20 MHz clock input

DC - 200 ns instruction cycle

• 1024 words of program memory

• 68 bytes of Data RAM

• 64 bytes of Data EEPROM

• 14-bit wide instruction words

• 8-bit wide data bytes

• 15 Special Function Hardware registers

10,000 erase/write cycles Enhanced FLASH

Program memory typical

• 10,000,000 typical erase/write cycles EEPROM

Data memory typical

• EEPROM Data Retention > 40 years

• In-Circuit Serial Programming™ (ICSP™) – via two pins

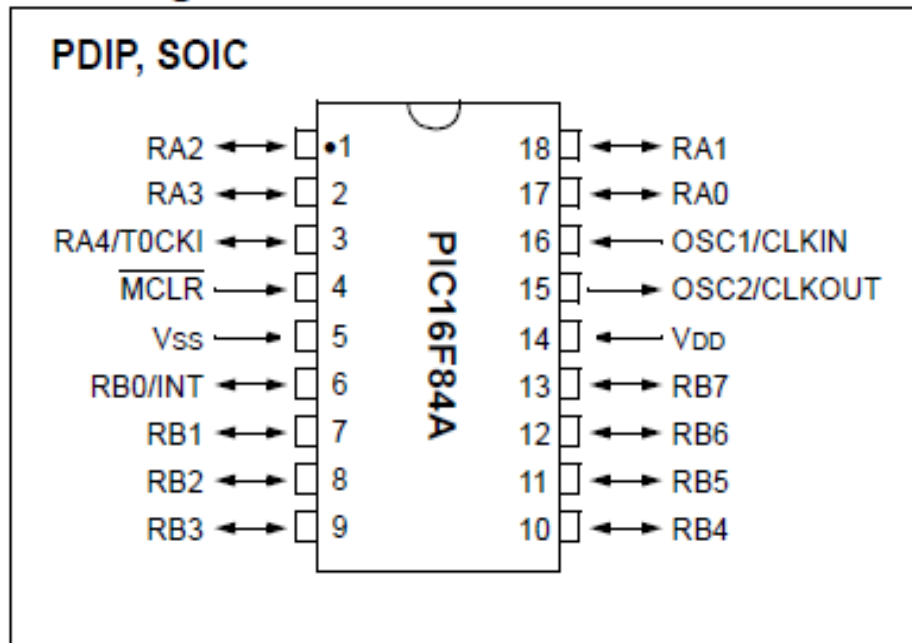• Power-on Reset (POR), Power-up Timer (PWRT),

Oscillator Start-up Timer (OST)

• Watchdog Timer (WDT) with its own On-Chip RC

Oscillator for reliable operation

• Code protection

• Power saving SLEEP mode

• Selectable oscillator options

## Pin Diagrams

PDIP, SOIC

```
                    PIC16F84A
RA2       ←→  □ •1        18 □  ←→  RA1
RA3       ←→  □  2        17 □  ←→  RA0
RA4/T0CKI ←→  □  3        16 □  ←   OSC1/CLKIN
MCLR      →   □  4        15 □   →  OSC2/CLKOUT
Vss       →   □  5        14 □  ←   VDD
RB0/INT   ←→  □  6        13 □  ←→  RB7
RB1       ←→  □  7        12 □  ←→  RB6
RB2       ←→  □  8        11 □  ←→  RB5
RB3       ←→  □  9        10 □  ←→  RB4
```

A PIC microcontroller is a processor with built in memory and RAM and you can use it to control your projects. So it saves you building a circuit that has separate external RAM, ROM and peripheral chips. The PIC series provides a family of micro controllers which are cost effective, flexible and suitable for a wide variety of applications. PICs are popular with both industrial developers and hobbyists alike due to their low cost, wide availability, large user base, extensive collection of application notes, availability of low cost or free development tools, and serial programming (and re-programming with flash memory) capability.

The PIC 16F84A belongs to the mid-range family of the PICmicro® microcontroller devices. The program memory contains 1K words, which translates to 1024 instructions, since each 14-bit program memory word is the same width as each device instruction. The data memory (RAM) contains 68 bytes . Data EEPROM is 64 bytes. There are also 13 I/O pins that are user-configured on a pin-to-pin basis. Some pins are multiplexed with other device functions.

The data memory is partitioned into two areas. The first is the Special Function Registers (SFR) area, while the second is the General Purpose Registers (GPR) area. The SFRs control the operation of the device. Each General Purpose Register (GPR) is 8-bits wide and is accessed either directly or indirectly through the FSR  The GPR addresses in Bank 1 are mapped to addresses in Bank 0. As an example, addressing location 0Ch or 8Ch will access the same GPR.

The special function registers can be classified into two sets, core and peripheral. Those associated with the core functions are described in this section. Those related to the operation of the peripheral features are described in the section for that specific feature The STATUS register contains the arithmetic status of the ALU, the RESET status and the bank select bit for data memory

The EEPROM data memory is readable and writable during normal operation (full VDD range). This memory is not directly mapped in the register file space. Instead it is indirectly addressed through the Special Function Registers. There are four SFRs used to read and write this memory

Some pins for these I/O ports are multiplexed with an alternate function for the peripheral features on the device. In general, when a peripheral is enabled, that pin may not be used as a general purpose I/O pin.
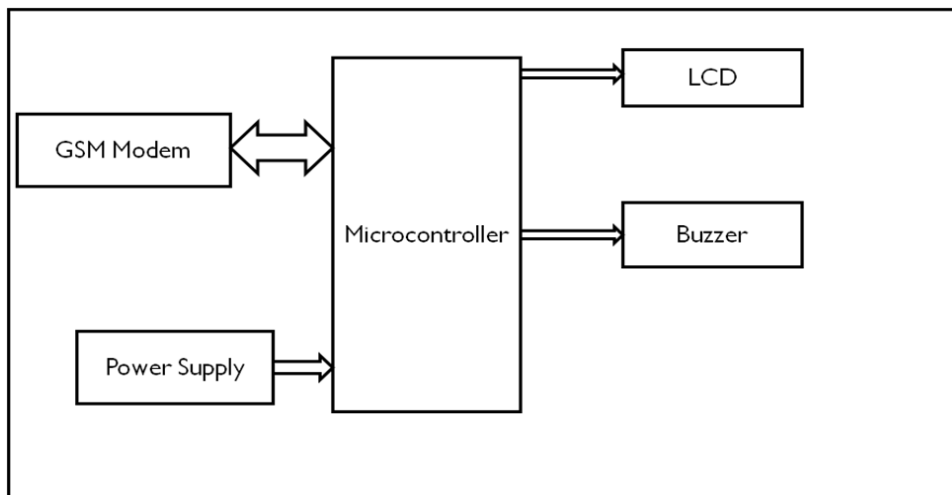
**Fig :Block diagram of monitoring center**

**Software Design of Monitoring Center:**

Software program of monitoring center mainly includes such functions: MT mobile terminated, databank, alarm, data collation, mapping curve, etc. Monitoring center PC communicates with GSM module by UART. Upper machine reads SMS data received by GSM, and then sorts out and puts them into a database, so it is easy for managements to manage and perform a backup.

Meanwhile, the data is plotted to curve and displayed on PC interface. As the SIM card in GSM module can store limited SMS data, it must delete the SMS timely after upper machine has read SMS. When the received data is abnormal, alarm indicator will be displayed on computer screen in the monitoring center, at the same time, the alarm of monitoring center will be switched on.

## 5.  CONCLUSION

water quality based on GSM makes use of water detection sensor with unique advantage and existing GSM network. The system can monitor water quality automatically, and it is low in cost and does not require people on duty. So the water quality testing is likely to be more economical, convenient and fast. The system has good flexibility. Only by replacing the corresponding sensors and changing the relevant software programs, this system can be used to monitor other water quality parameters. The operation is simple. The system can be expanded to monitor hydrologic, air pollution, industrial and agricultural production and so on. It has widespread application and extension value.

This paper explains water quality and quantity monitoring system using WSN with three main parts namely hardware and software of data nodes and base station and a software for remote Monitoring of Turbidity, PH & Temperature of Water makes use of water detection sensor with unique advantage and existing GSM network. The system can monitor water quality automatically, and it is low in cost and does not require people on duty. So the water quality testing is likely to be more economical, convenient and fast. The system has good flexibility.

The system is reliable and simple and it can be extended to measure air pollution and so on. It has widespread application.
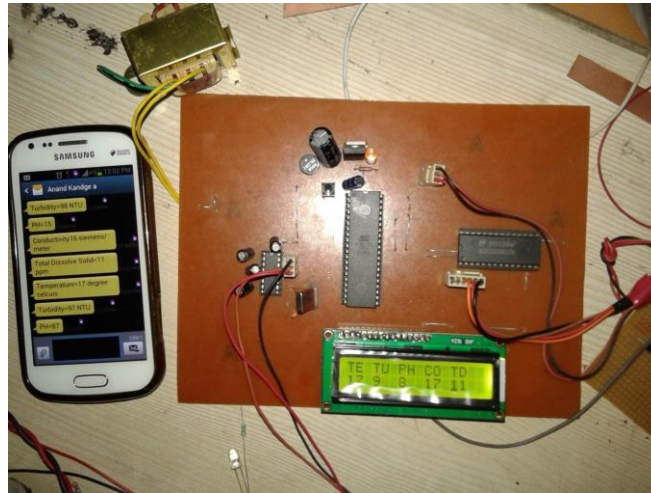
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