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Unified intelligent water management using Cyber infrastructure based on cloud computing and IoT

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Abstract: In this project, we are focusing on continuous and real time monitoring of water supply in IOT platform. Water supply with continuous monitoring makes a proper distribution so that, we can have a record of available amount of water in tanks, flow rate, abnormality in distribution line. Internet of things is nothing but the network of physical objects embedded with electronics, sensors, software, and network connectivity. Monitoring can be done from anywhere as central office. Using thing speak as free server data continuously pushed on cloud so we can see data in real time operation. Using different sensors with controller and raspberry pi as Minicomputer can monitor data and also control operation from cloud with efficient client server communication.

Keywords: Water Management; Cyber Infrastructures; Cloud Computing; IOT.

1. INTRODUCTION

Water is an important resource for all the livings on the earth. In that, some people are not getting sufficient amount of water because of unequal distribution. We can use this approach so that everyone gets the equal amount of water. It is also used to avoid the wastage of water during the distribution period. In the previous method, the employee will go to that place and open the valve for a particular duration, then again the employee will go to the same place and close the valve, it is waste of time. The proposed system is fully automated. Here human work and time are saved. To ensure the safe supply of drinking water the quality should be monitored in real time for that purpose new approach IOT (Internet of Things) based water quality monitoring has been proposed. In this project, we will implement the design of IOT base water quality monitoring system that monitors the quality of water in real time. This system consists some sensors which measure the water quality parameter. The real-time monitoring of water resources information will benefit the water resources management department and the public. The primary concept of real-time IOT based water resources information system is to provide comprehensive and accurate information. The system is developed through defining some explicit water resource parameters then, Water level and flow parameter are defined for water measure & management, followed by a sensor network for water resources information monitoring is constructed based on IOT.

BLOCK DIAGRAM

The ability to monitor water level and to protect water from wastage is an important issue through the fields of the environment as well as engineering. Our IOT based system consists of two solenoid valve, Ultrasonic sensor for level measurement, controller, flow rate sensor and sensors for water quality check like pH, conductivity. The block diagram of the designed system is given in Figure 1.1.

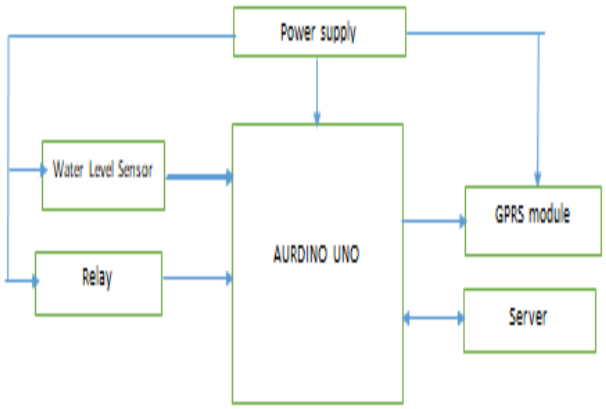

Figure 1.1: Block Diagram.

2. EMBEDDED SYSTEM

An embedded system is a special-purpose computer system designed is used to perform one or few dedicated functions, sometimes with real time computing constraints. It is usually embedded as a part of complete device including hardware and mechanical parts. In contrast general purpose computer, such as personal computer, can do many different tasks depending on programming. Embedded systems have become very important today as they control many of the common devices we use.

Since the embedded system is dedicated to specific tasks, design engineers can optimize it, reducing the cost of the product, or increasing the reliability and performance. Some embedded systems are mass produced, benefiting from economies of scale.

In general "embedded system" is not an exactly defined term, as many systems have some elements of programmability. For example, Handheld computers share some elements with embedded systems – such as the operating systems and microprocessors which power them – but are not truly embedded systems, because they allow different applications to be loaded and peripherals to be connected.

An embedded system is some combination of computer hardware and software, either fixed in capability or programmable, that is specifically designed for a particular kind of application device. Industrial machines, automobiles, medical equipment, cameras, household appliances, airplanes, vending machines, and toys (as well as the more obvious cellular phone and PDA) are among the myriad possible hosts of an embedded system. Embedded systems that are programmable are provided with a programming interface, an embedded systems programming is a specialized occupation.

The microprocessor –based systems built for controlling function or range of functions and are not designed to be programmed by the end user in the same way a PC is defined as an embedded system. An embedded system is designed to perform one particular task albeit with different choices and options.

Embedded systems contain processing cores that are either microcontrollers or digital signal processors. Microcontrollers as "chip", which may itself be packaged with other microcontrollers in a hybrid system of Application- Specific Integrated Circuit (ASIC).In general, input always comes from a detector or sensors in more specific word and meanwhile the output goes to the activator which may start or stop the operation of the machine or the operating system.

Applications Of Embedded System

- Military and aerospace software applications
- Communication applications
- Electronic applications and consumer devices
- Industrial automation and process control software

3. ARDUINO

An Arduino is an open source hardware platform with built in programming support. No additional hardware or software (e.g. Hex burner) is required to transfer your programs (i.e. hex file) to the Arduin0. There are all the necessary peripherals attached for the basic operation. It is based on simple AVR microcontrollers.

Arduino is a growing industry nowadays and the major reason behind it is the vast majority of libraries. Users don't have to invent the wheel again. Long traditional codes have been reduced to few lines now. It is easy to use and enhance productivity. Arduino can be used to make a variety of projects taking analogue as well as digital inputs and can easily interface with different hardware like switches, encoders, Sensors, Motors, relays and many more.

Arduino UNO Salient Features Are:

Microcontroller ATmega328	(MCU)
Operating Voltage (DC)	5V
Input Supply Voltage (External) (MAX)	6-20VDC
Recommended Input Supply Voltage (DC)	7-12V
Number of Digital Input / Output (I/O) Pins	14
PWM (Pulse Width Modulation) outputs 5, 6,9,10 and 11)	6 (Pin 3,
Input Pins (Analog)	6 (A0-A5)
DC Current (Max) (per I/O Pin)	40 mA
DC Current for 3.3V Pin	50 mA
Flash Memory (ATmega328) (0.5 KB used by boot-loader)	32 KB
Clock Speed (Ceramic Resonator)	16 MHz
SRAM (Memory) (ATmega328 MCU)	2 KB
EEPROM (Memory) (ATmega328 M	1 KB

The Arduino Uno is used as a microcontroller in this system, it has 14 digital input/output pins of which we are using 6 pins for connecting sensors-pH, conductivity, ultrasonic, Water flow rate and solenoid valves, and can be used as

PWM outputs, a USB connection, a power jack and a reset button is also present. We are interfacing Wi-Fi module ESP8266 for giving it an internet based approach.

Figure 1.2: Arduino Uno.

WATER LEVEL SENSOR

Water level sensor will help us decide if we have enough quantity of water to be supplied. If the tank is empty water flow and a quality check will be on hold and if the tank is full then, water can be distributed after a quality check. Ultrasonic sensor HC-SR04 is used to measure distance in the range of 2cm-400cm with an accuracy of 3mm. The ultrasonic sensor module works on the natural phenomenon of ECHO of sound.

RELAY

Relay are switches that open and close circuits electromechanically or electronically. Relays control one electrical circuit by opening and closing contacts in another circuit. As relay diagrams show, when a relay contact is normally open there is an open contact when the relay is energized.

Figure 1.3: Relay.

GPRS

GPRS modem is a GSM modem that additionally supports the GPRS techonology for data transmission. GPRS stands for General Packet Radio Service. It is a packed switch technology that is an extension of GSM. General Packet Radio Services (GPRS) is a packet-based wireless communication service that promises data rates from 56 up to 114 Kbps and continuous connection to the Internet for mobile phone and computer users. The higher data rates allow users to take part in video conferences and interact with multimedia Web sites and similar applications using mobile handheld devices as well as notebook computers. GPRS is based on Global System for Mobile (GSM) communication and complements existing services such circuit-switched cellular phone connections and the Short Message Service (SMS).

CAPACITORS

A capacitor or condenser is a passive electronic component consisting of a pair of conductors separated by a dielectric. When a voltage potential difference exists between the conductors, an electric field is present in the dielectric. This field stores energy and produces a mechanical force between the plates. The effect is greatest between wide, flat, parallel, narrowly separated conductors.

An ideal capacitor is characterized by a single constant value, capacitance, which is measured in farads. This is the ratio of the electric charge on each conductor to the potential difference between them. In practice, the dielectric between the plates passes a small amount of leakage current. The conductors and leads introduce an equivalent series resistance and the dielectric has an electric field strength limit resulting in a breakdown voltage.

The properties of capacitors in a circuit may determine the resonant frequency and quality factor of a resonant circuit, power dissipation and operating frequency in a digital logic circuit, energy capacity in a high-power system, and many other important aspects.

Figure 1.4: Capacitors.

RESISTORS

A resistor is a two-terminal electronic component designed to oppose an electric current by producing a voltage drop between its terminals in proportion to the current, that is, in accordance with Ohm's law:

$$V = IR$$

Resistors are used as part of electrical networks and electronic circuits. They are extremely commonplace in most electronic equipment. Practical resistors can be made of various compounds and films, as well as resistance wire (wire made of a high-resistivity alloy, such as nickel/chrome).

The primary characteristics of resistors are their resistance and the power they can dissipate. Other characteristics include temperature coefficient, noise, and inductance. Less well-known is critical resistance, the value below which power dissipation limits the maximum permitted current flow, and above which the limit is applied voltage. Critical resistance depends upon the materials constituting the resistor as well as its physical dimensions; it's determined by design.

Figure 1.5: Resistors.

Resistors can be integrated into hybrid and printed circuits, as well as integrated circuits. Size, and position of leads (or terminals) are relevant to equipment designers; resistors must be physically large enough not to overheat when dissipating their power.

4. PROTOCOLS LAYERS

Four GPRS coding schemes CS1, CS2, CS3 and CS4 are defined, whose characteristics are listed in Table I. Initially only CS1 and CS2 will be developed. The table indicates that the GPRS channel coding schemes increase data rate at the cost of decreasing protection (correction capability). These coding schemes also reduce worst link budget and cell range. For GSM, the worst link budget is 142.5 dB and the maximum cell range is 730 m. On the other hand, the GPRS worst link budget is 135–128.5 dB and the maximum cell range is 450–290 m.

Table 1.1: Characteristics Of The GPRS Coding Schemes.

Coding scheme	CS1	CS2	CS3	CS4
User data rate	9.05 Kb s^{-1}	13.4 Kb s^{-1}	15.6 Kb s^{-1}	21.4 Kb s^{-1}
Correction capability	Highest			None
Worst link budget	135 dB	133 dB	131 dB	128.5 dB
Maximum cell range	450 m	390 m	350 m	290 m

Evolving From GSM To GPRS

By reusing GSM infrastructure, most GPRS implementation costs of the existing GSM nodes are software related. As illustrated in Table II, major hardware impact on the GSM network is limited to the addition of a PCU-model to the BSC and the introduction of two new node types: SGSN and GGSN. GPRS software upgrade can be performed efficiently. In many vendor solutions, GPRS software can be remotely downloaded to BTSs, so that no site visits are needed. In the MS development, a major challenge is to resolve power consumption issue. To support data-related features (e.g., multiple timeslots transmission), GPRS MS consumes much more power than a standard GSM MS.

Table 1.1: GSM Network Elements Impact By GPRS.

Element	Software	Hardware
MS	Upgraded required	Upgraded required
BTS	Upgraded required	No change
BSC	Upgraded required	PCU interface
TRAU	No change	No change
MSC/VLR	Upgraded required	No change
HLR	Upgraded required	No change
SGSN	New	New
GGSN	New	New

The GPRS protocols have a good characteristic in that each layer can be reused to support features in different GPRS nodes. The GPRS stack is designed so that multiple copies of every layer can be distributed across multiple processors.

5. RESULT

Once the device us powered up, check whether SIM card is present. If the SIM is not inserted properly or if the SIM card is locked, please correct those issues.

AT+CPIN?

+CPIN: READY

OK

The device above returns that the SIM is ready to use.

OK

IP Address of the connected profile is “30.38.217.74″

AT+CGDCONT?

+CGDCONT: 1,”IP”,”epc.tmobile.com”,”30.38.217.74″,0,0

OK

Following connection profiles are available,

CID-> 1

PDP Type->IP

APN->epc.tmobile.com

PDP Address->30.38.217.74

Data Compression->0

Header Compression->0

AT+CGACT=0,1

OK

Dis-connect is successful

AT+CGATT=0

OK

SAMPLE CODE:

```
void setup()
{
Serial.begin(9600);
delay(5000);
}
void loop()
{
Serial.println("AT");
delay(1000);
Serial.println("AT+CMGF=1");
delay(1000);
Serial.println("AT+CMGS=\"1234567890\""); //CHANGE TO DESTINATION NUMBER
delay(1000);
Serial.print("hi");
Serial.write(26);
delay(1000);
}
```

Step 6 : Padding configuration

Short 3 and 2 by manual soldering to select hardware RX and TX(D0 and D1)

Or

Short 1 and 2 by manual soldering to select Software RX and TX (D2 and D3)

*default padding is set D0 and D1

SPOWER MODES

Power down mode

SIM900A is set power down mode by “AT+CPOWD=0”

There are two methods for the module to enter into low current consumption status

Minimum Functionality Mode

Minimum functionality mode reduces the functionality of the module to a minimum and thus minimizes the current consumption to the lowest level.

If SIM900A has been set to minimum functionality by "AT+CFUN=0" If SIM900A has been set to full functionality by "AT+CFUN=1"

If SIM900A is set "AT+CFUN=4" to disable both the above functionality.

5. CONCLUSION

Using this this system secure and continuous monitoring is possible No need to go on field for monitoring so manual work has reduced it makes system more efficient, reliable, low cost and accurate we can Data monitored from anywhere controlling is possible from a remote server it is Economical in development.