

Wireless Sensor Based Remote Monitoring System For Fluoride Affected Areas Using GPRS and GIS

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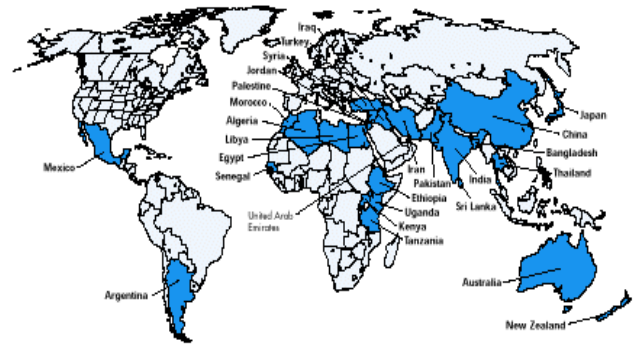
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ABSTRACT: Recent developments in the availability of low-cost integrated General Packet Radio Service (GPRS)/Global Positioning Systems (GPS) modem and publically available web based Geographical Information Systems (GIS) have enabled the development of embedded stand-alone monitoring systems. But there is no such technology, or method exists for fluoride monitoring in water and soil. This paper presents the design, implementation of remote fluoride monitoring system that utilizes online Map from a GIS in conjunction with the readily available public satellite-based GPS, and GPRS mobile networks. The system allows remotely monitor various fluoride sensors status via their mobile phone or by using the Internet. This system can also be utilized by people in fluoride affected areas, government organizations and municipalities to continuously monitor

Keywords - Embedded Systems, GPRS, GIS, Remote Monitoring.

I. INTRODUCTION

The latest information shows that fluorosis is endemic in at least 25 countries across the globe (see map)[1]. The total number of people affected is not known, but a conservative estimate would number in the tens of millions. 15 of India's 32 states were identified as endemic for fluorosis. In Mexico, 5 million people (about 6% of the population) are affected by fluoride in groundwater. Fluorosis is prevalent in some parts of central and western China, and caused not only by drinking fluoride in groundwater but also by breathing airborne fluoride released from the burning of fluoride-laden coal. Worldwide, such instances of industrial fluorosis are on the rise.



Countries with endemic fluorosis due to excess fluoride in drinking water

Some governments are not yet fully aware of the fluoride problem or convinced of its adverse impact on their populations. Efforts are therefore needed to support more research on the subject and promote systematic policy responses by governments-W.H.O[1]. fluoride is found in both surface waters and groundwater. In surface freshwater, however, fluoride concentrations are usually low - 0.01 ppm to 0.3 ppm. In groundwater, the natural concentration of fluoride depends on the geological, chemical and physical characteristics of the aquifer, the porosity and acidity of the soil and rocks, the temperature, the action of other chemical elements, and the depth of wells. Because of the large number of variables, the fluoride concentrations in groundwater can range from well under 1 ppm to more than 35 ppm. In Kenya and South Africa, the levels can exceed 25 ppm. In India, concentrations up to 38.5 ppm have been reported.

To measure fluoride content in water and soil we are using conventional approaches still there is no technology based system is exist to monitor the status of fluoride in a particular area.

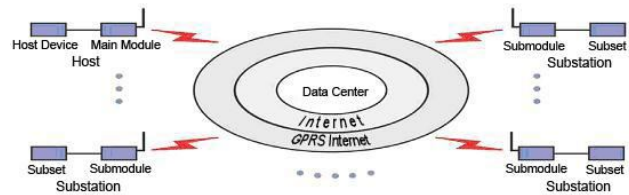
II. LITERATURE SURVAY

Several systems using Bluetooth, Infrared (IR), Zigbee and Radio Frequency Identification System (RFID) based communication protocols have already been utilized to wirelessly monitor within a short range of areas. For example, the Bluetooth technology was utilized to build an irrigation system [1]. Wireless Sensor Based Remote Monitoring System for Agriculture Using ZigBee and GPS [] There are many types of remote water monitoring systems available including cellular data loggers[6], satellite data transmission systems[3],[4], standard modems for remote water monitoring system[7]. Each of these data transmission methods meets different remote water monitoring system needs.

The above mentioned systems are utilized for local monitoring or remote monitoring using wireless components like wireless access points and GSM/GPRS modems. Typically, such systems have been implemented using two or three hardware boards to perform the monitoring and control task. However, advances in technology have enabled the design and development of integrated monitoring and control systems that are cheaper, smaller, consume less power, have enhanced functionality and utilize publicly available GIS navigation services such as online maps. Using publicly available networks enhances and extends the monitoring and control.

III. MATERIALS AND METHODS

This paper presents the design and implementation of a compact wireless centralized (see figure1) fluoride monitoring system using a microcontroller and GPRS modem that are integrated on a single board (Micro-GPRS) unit [15].

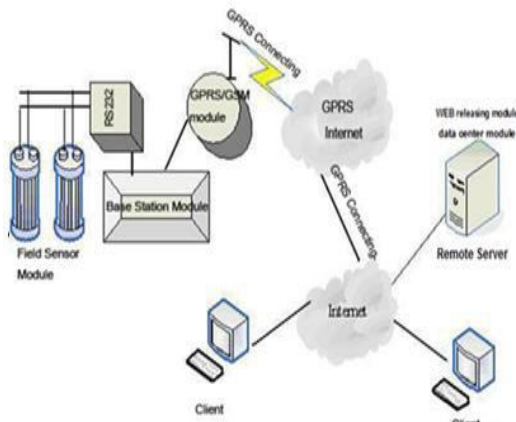


The Micro-GPRS unit is an off-the-shelf board and has several built-in analog inputs and digital input/output (I/O) ports as well as a GPRS-GPS modem. Since Micro-GPRS unit has a built-in data acquisition unit, there is no need for programming the I/O ports; only threshold of parameters require configuration. The unit is interfaced with external sensors via its analog and digital inputs. The Micro-GPRS unit and the associated sensors are installed in the fluoride effected area including wells grounds. The threshold for the each analog input is configured via the unit's serial port using a host PC. If fluoride is sensed, the Micro-GPRS transmits an appropriate message indicating the status of monitored sensors to an Internet-based server using a static IP-address. In addition to the single-board feature and no programming, the system also utilizes a widely available Internet-based GIS to display the exact location of the monitored area as well as the status level, time and date. This online map feature can also be utilized by the organizations and government to continuously monitor and locate troublesome spots in residential neighbor areas. Advances in technology have enabled the design and development of integrated monitoring and control systems that are cheaper, smaller, consume less power, have enhanced functionality and utilize publicly available GIS navigation services such as online maps.

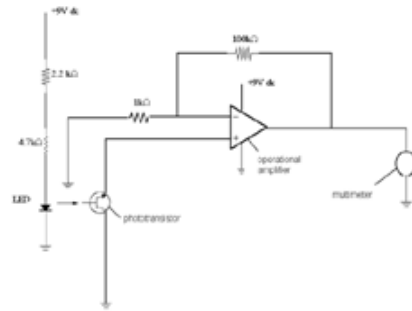
The system is designed to have two sub systems TCP/IP enabled Micro GPRS and set of sensors which is located at fluoride effected areas. And Monitoring center which is located at monitoring agencies that is government organizations or service providers. Monitoring center uses the online map servers GIS capabilities, to show live maps.

A. System hardware

Figure 2 shows the hardware building blocks



Fluoride sensor: The device is a low cost colorimeter, which detects the change in the fluoride concentration of a solution depending upon the change in colour of the solution. The method is based on the principle of colorimetry. When light falls on a coloured system, a part of the light will be absorbed and reflected by it and the rest is transmitted. We choose a coloured chemical system whose colour changes when water containing fluoride comes in contact with it. The intensity of the transmitted light depends on the colour of the solution and hence the amount of fluoride present in the solution. The intensity can be measured using a detector and can be correlated with concentration of fluoride ions in the solution (CF). When the intensity of the transmitted light changes, the signal from the detector changes accordingly, and this in turn changes the output voltage. This change in voltage is measured and is correlated with CF. Below figure shows the circuit diagram for fluoride sensor. Figure 3.1: Circuit diagram of the fluoride colorimeter developed by Sen et al. (1998)



Micro GPRS board: this board is used for continuous monitoring activity on 24/7 and Micro GPRS is used for M2M communication[15] the Micro GPRS is IP enabled and has a static IP address to communicate with a server through the public wireless mobile network. It support SMS,SMTP,POP and FTP protocols. The Micro GPRS has a built-in analog inputs and digital I/O ports these ports are used to eliminate the need for external micro controller for handling inputs and outputs.

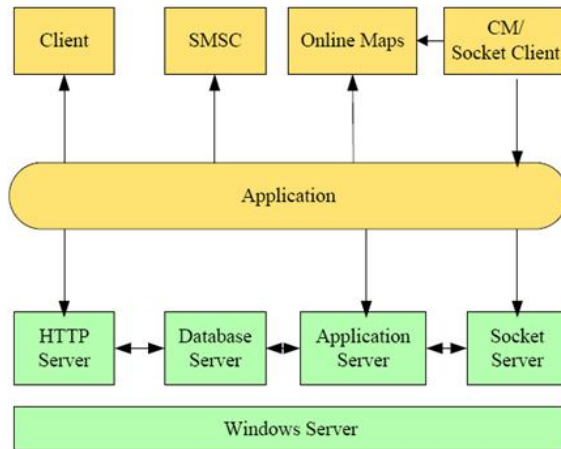
B. System software

the system software architecture for the system is described in 3 parts

1. Micro GPRS.
2. Monitoring center
3. GIS online map server

Micro GPRS: The micro GPRS does not require any programming. It only needs to be configured for the analog threshold for each sensor. This configuration must be done using the software driver that comes with the modem. The Micro GPRS hardware is configured via its RS-232 port before installation.

Monitoring center: The Monitoring center is built on top of the Windows Operating System and it uses multiple interacting servers to implement its functionality. The servers are HTTP, Database, Application and Socket Server.



Each of these servers is briefly described below:

HTTP Server: The HTTP server is a standard Web server that allows clients to connect over the Internet or through a GPRS network. The system is currently using an open source server [18].

Database Server: An open-source database server [19] is used to profile fluoride effected areas and statuses.

Application Server: The Application Server serves as the glue between the HTTP server and the other servers including the Database Server. The system used an open-source Application server [17].

Sockets Server: The Sockets Server is a customized multi-threaded sockets server written in the Java language [14]. For each client socket connection, the server launches a thread that connects to the database server and updates the status of the particular monitoring area.

SMSC: SMS Center it connects with the mobile networks service provider SMSC server send an appropriate SMS to the requesting party.

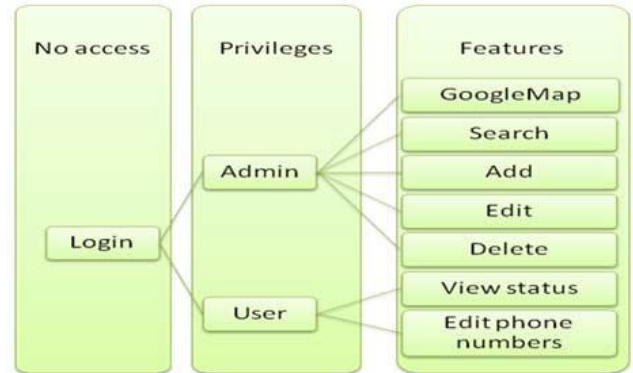


Fig 8. Creating and editing user's information screen shot.

An administrator is able to do various operations including network administration and database management, In addition, an administrator is able to conduct search and configure the online Maps server. etc.

Online Maps: This server is developed using a published software interface from a freely available Internet-based GIS [18]. The Online Maps server dynamically show the status of fluoride in an Internet browser running either on a normal computer or a mobile phone.

IV. CONCLUSION

Solving fluoride problem may take years with varies prevention techniques and alternative solutions [1]. While applying this prevention techniques use this system to get the current data of fluoride content in all area and the prevention techniques status is also estimated.

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