Design and Implementation of Base Board and the Internet Communication System Based on GPRS

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Abstract — The project mainly aims in design and implementation of Base board and the internet communication system based on GPRS. For such an environment, such as radiation, pollution, dangerous, distributed environment where the staff is not easy to reach, it is difficult to complete data collection and real-time monitoring through the traditional manual method. The study of remote wireless monitoring system, which based on the Base board and GPRS (General Packet Radio Service) architecture, can well meet the needs of these applications. This paper introduces the overall system architecture, discusses in detail the key technology of the communication between Base board and the Internet.

The controlling device of the whole system is done using ARM-7 Microcontroller. Whenever the sensors unit gets the input from respected sensors like pollution sensor, optical sensor and Magnetic sensor at the same time there will be Buzzer indication whenever these values exceeds the threshold limit. These inputs are fed to the ARM 7 microcontroller and performs appropriate task that it is interfaced with GPRS module which is used to display the related received sensors data directly to the predefined webpage. And we can also control the devices using GPRS SMS services like motor ON/OFF control system.

Keywords: ARM7 (LPC2148), GPRS, Sensors, DC motor, PC and Front end design.

I. INTRODUCTION

In electric power, heat, weather and river pollution management and other industries of city, due to long distance between the monitoring sites, distribution separately, a lot of manpower and material resources is usually necessary to control and liaison with the center management station. A few of automated management cities is most based on telephone line, modem, or radio stations, so the cost is high and the efficiency is low. In addition, if the environment is too bad to lay telephone lines and the message is required to be submitted to the centre in real time, the traditional method can’t accomplish the task. GPRS wireless data communication network used to solve the above problem can provide a reasonable use of the channel.

General Packet Radio Service GPRS (General Packet Radio Service) is a system based on GSM wireless packet as a switching technology to provide end to end, wide-area wireless IP connectivity[1]. GPRS is a high-speed wireless data transfer technology, and data is "clustered" in the form of the air channel through the GSM transmission. Although the GPRS network as the existing GSM evolution to third generation mobile communication technology transition, but it has many significant advantages. With packet data network (Internet, etc.) directly to each other, at any time online (always online), and billing by using a more reasonable flow of billing method is particularly suitable for small flow needs Frequent data transmission applications, such as urban electricity, heat, weather, and river pollution control and other industries.

II. OVERALL DESIGN

Remote monitoring system designed in this paper is based on microcontroller and PIML GPRS module as the core, to achieve 3-sensor data, 1 A / D control, local time display, remote Internet monitoring. Overall system consists of four parts: The first part is based on an embedded microcontroller core frontend acquisition system, the second part is based on GPRS communication system, the third part is Internet-based monitoring center, and the last one is the remote execution unit.

The system structure is shown in Figure 1, the remote monitoring center through the GPRS network to monitor the N-channel remote sites. Overall process is: to capture the embedded microcontroller as the core front-end for distributed multi-sensor information site (radiation level, pollution, alarm signal, optical, magnetic, temperature, pressure, flow, speed, etc.) real-time collection, coding; through GPRS channel real-time monitoring data sent to the WEB server (fixed IP address or a fixed domain name website), the monitoring center to receive includes time, site code, data and other information; the same time embedded micro-manage the acquisition front-
end real time reception control center to send to the front restart immediately upload data, change the upload cycle, time calibration, control and other commands to perform an action.

GPRS Modem

General Packet Radio Service - (GPRS) A GSM data transmission technique that does not set up a continuous channel from a portable terminal for the transmission and reception of data, but transmits and receives data in packets. It makes very efficient use of available radio spectrum, and users pay only for the volume of data sent and received.

In this project using this gprs modem used to display the related received sensors data directly to the predefined webpage and we can also control the operation of motor on/off conditions with help of gprs sms.

Pollution Sensor

The sensor is designed for indoor air quality testing. The main gas detected is carbon monoxide, alcohol, acetone, thinner, formaldehyde and other slightly toxic gases. The signal of sensor's is analog which cannot be used as the standard of air pollution. Calculate the rate of voltage risen in unit time then judge the pollution level according the rate.

Optical Sensor

The CNY70 has a compact construction where the emitting light source and the detector are arranged in the same direction to sense the presence of an object by using the reflective IR beam from the object. The operating wavelength is 950 nm. The detector consists of a photo transistor.

Magnetic Sensor

Inductive Proximity Sensors detect the presence of metal objects which come within range of their oscillating field and provide target detection to zero speed. Internally, an oscillator creates a high frequency electromagnetic field (RF) which is radiated from the coil and out from the sensor face. When a metal object enters this field, eddy currents are induced into the object.

LCD Display Section

This section is basically meant to show up the status of the project. This project makes use of Liquid Crystal Display to display / prompt for necessary information.

Buzzer

This is the output device which we are using to indicate the unwanted situation. That means when pollution exceeds the threshold value Buzzer will be on.
Motor

Motor is an output device. Based on the Message coming from owner number through mobile the motor will be ON and OFF. The speed of DC motor is directly proportional to armature voltage and inversely proportional to flux. By maintaining the flux constant, the speed can be varied by varying the armature voltage.

B. Interface GPRS Hardware Design

GPRS communication module selection PIML GPRS module, dual-band GSM / GPRS engine that supporting data, voice, SMS and fax transmission, network communication protocols to support TCP or UDP based data transfer protocol. GPRS-based communication system, shown in Fig., Front-end acquisition system microcontroller via the serial port, use the AT command communication with the GPRS module, GPRS module will route the data through the service node to the specified IP address, Internet monitoring center. Monitoring center at the same time came to send control commands to the front of the site acquisition system.

GPRS

GPRS (General Packet Radio Service) is a non-voice service added to existing TDMA networks, one of the 2.5G technology upgrades. TDMA is the underlying transport echanism used by GSM networks. GPRS provides the transmission of IP packets over existing cellular networks.

How does it work?

GPRS is a network overlay to the existing cellular network. It uses the nature of IP transmissions to its advantage. Because IP traffic is made of "packets", the network does not need to have continuous data transmission. Thus, IP traffic can easily share the channels. A user may be receiving or transmitting data while another one is reading information.

Table 1: GPRS Modem Details

<table>
<thead>
<tr>
<th>Document Title</th>
<th>SIM300 AT Commands Set</th>
</tr>
</thead>
<tbody>
<tr>
<td>Version</td>
<td>1.06</td>
</tr>
<tr>
<td>Date</td>
<td>2006-12-04</td>
</tr>
<tr>
<td>Status</td>
<td>Release</td>
</tr>
<tr>
<td>Document Control ID</td>
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Conventions and Abbreviations

In this document, the GSM engines are referred to as following term:
1) ME (Mobile Equipment);
2) MS (Mobile Station);
3) TA (Terminal Adapter);
4) DCE (Data Communication Equipment) or facsimile DCE(FAX modem, FAX board);
In application, controlling device controls the GSM engine by sending AT Command via its serial interface. The controlling device at the other end of the serial line is referred to as following term:

1) TE (Terminal Equipment);
2) DTE (Data Terminal Equipment) or plainly “the application” which is running on an embedded system;

**AT Command Syntax**

The "AT" or "at" prefix must be set at the beginning of each command line. To terminate a command line enter <CR>. Commands are usually followed by a response that includes."<CR><LF><response><CR><LF>”Throughout this document, only the responses are presented, <CR><LF> are omitted intentionally.

The AT command set implemented by SIM300 is a combination of GSM07.05, GSM07.07 and ITU-T recommendation V.25ter and the AT commands developed by SIMCOM.

**AT Commands for GPRS**

<table>
<thead>
<tr>
<th>Command</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>AT+CSTT</td>
<td>Start Task And Set App, User Name, Password</td>
</tr>
<tr>
<td>AT+CIICR</td>
<td>Bring Up Wireless Connection With Gprs Or Csd</td>
</tr>
<tr>
<td>AT+CIFSR</td>
<td>Get Local IP Address</td>
</tr>
<tr>
<td>AT+CIPSTART</td>
<td>Start Up Tcp Or Udp Connection</td>
</tr>
<tr>
<td>AT+CIPSEND</td>
<td>Send Data Through Tcp Or Udp Connection</td>
</tr>
</tbody>
</table>

**Table 2: GPRS Modem Command set**

The General Packet Radio Service (GPRS) is a new non-voice value added service that allows information to be sent and received across a mobile telephone network. It supplements today’s Circuit Switched Data and Short Message Service. GPRS is NOT related to GPS (the Global Positioning System), a similar acronym that is often used in mobile contexts.

Enabling GPRS on a GSM network requires the addition of two core modules, the Gateway GPRS Service Node (GGSN) and the Serving GPRS Service Node (SGSN). As the word Gateway in its name suggests, the GGSN acts as a gateway between the GPRS network and Public Data Networks such as IP and X.25. GGSNs also connect to other GPRS networks to facilitate GPRS roaming. The Serving GPRS Support Node (SGSN) provides packet routing to and from the SGSN service area for all users in that service area.

In addition to adding multiple GPRS nodes and a GPRS backbone, some other technical changes that need to be added to a GSM network to implement a GPRS service. These include the addition of Packet Control Units; often hosted in the Base Station Subsystems, mobility management to locate the GPRS Mobile Station, a new air interface for packet traffic, new security features such as ciphering and new GPRS specific signalling.

**Embedded Internet Software Design**

Base Board using C language programming, via the serial port on the GPRS module to read and write operation is completed. In the system, GPRS module is equivalent to the serial of Base Board, Data is equivalent to Base Board serial data. Therefore, the use of the serial port is Critical work. Serial port using interrupt calls. Serial port interrupt service routine completion of data sending and receiving and other functions, First, initialization, and then set the landing mode to GPRS data mode, then Setting GPRS packet protocol, the entrance , Set connection mode setting, entry address, next Set IP address, port number. It is noteworthy that, the IP address and port number is corresponding to the remote monitoring center services’ IP and monitoring software’s Port. Finally, Finally, by using the AT command, AT +CIPSEND = 03,complete the data transmission, Among them, 103 is the amount of data the data format.

When the data transmission is complete, using AT command, AT+CIPCLOSE and AT+CIPSHUT to disconnect connection , and to close GPRS. So far, the complete process, which Base Board log internet, and send the data to internet, is over. Monitoring center is to receive the data and send control commands. Monitoring center services program is based on VC++6.0, using Socket programming technology. Socket
programming should focus on dealing with the use of several functions, the establishment of the socket (Socket()), bind (Bind()), listen (Listen()), receiver (Accept()) and reading (Recv()), write (Send()) and so on. Based on the above, the custom of the eight commands for handling the management of remote monitoring systems.

The following is the flow chart

Figure 5: Flow chart of overall design

Description for flow chart

In this design, we use Embedded C language as the programming language. Figure shows the Software process flows.

- Firstly, system and GPRS are initialized.
- Data is collected from the sensor circuit board. In this paper we are using pollution sensor, magnetic sensor and optical sensor.
- The collected sensors data is displayed on Liquid crystal display.
- Magnetic sensor is for whether the door has been closed or not.
- When the door closed Magnetic sensor detects the condition of the door, and sends information to our system Through GPRS.
- Then we will get the information as “DOOR CLOSED”.
- When the door opened, in this condition we will get the information as “DOOR OPEN”.
- Optical sensor detects the person whether he/she was entered or not.
- In this condition optical sensor detects and transmits the information to the controller.
- After by using GPRS we will get the message in our system as “PERSON ENTERED”.
- Similarly when the person again detected by the optical sensor, “PERSON EXIT” message will be received into our system.
- Pollution sensor detects the condition of pollution in our surroundings.
- Pollution sensor threshold level is already stored in code.
- Compare the pollution sensor value with its threshold value.
- If the pollution sensor value is exceed from its threshold level then buzzer will on.
- Otherwise, microcontroller will send the data through GPRS to SERVER.
- After that we have to wait till the message will come from server.
- If he get the message from server then microcontroller check whether the message is valid or not.
- If the message is valid then the corresponding device will be controlled.
- If the message in invalid then process starts from beginning.

III . EXPERIMENTAL RESULTS

This project consisting Optical Sensor, Magnetic Sensor, Pollution Sensor. Optical sensor detect the person whether he/she was entered or not, her e we are placing this sensor near to the door, when the person entered, in this condition optical sensor detects and transmit the information to the controller, after by using GPRS we will get the message in our system as “PERSON ENTERED “. Similarly when the person again detected by the optical sensor, “PERSON EXIT” message will be received into our system.
Figure 6: Hardware Design

Magnetic sensor is for whether the door has been closed or not. When the door closed magnetic sensor detect the condition of the door, and send information to our system through GPRS, then we will get the information as “DOOR CLOSED”, and when the door open, in this condition we will get the information as “DOOR OPEN”.

Figure 7: Frame Work Design

Pollution sensor working for checking the condition of pollution in our surrounding. In this project we are placing certain THRESHOLD CONDITIONS. By this sensor it checks the pollution and continuously we will get the values into our system through GPRS. When the pollution values exceed our threshold conditions i.e (>25ppm), it will give the alerting to us with BUZZER (Buzzer will be on).

IV. CONCLUSION

Using GPRS based SCADA system, any industrial plant can be monitored remotely. It improves reliability, response time, plant interface under continuous real time monitoring and under adverse environmental conditions for maximizing the industrial plant performance. This system can be used in oil/gas, environment monitoring, and water distribution application, covering a wide area and functioning under harsh conditions, and at the same time affordable and inexpensive to operate. By implementing such system, huge amount of savings can be obtained.

V. FUTURE APPLICATION

- Up to now by this system we are getting data into our system through GPRS for monitoring only, but by this GPRS automatically controlling also perform.

VI. BENEFITS

- The GPRS provides broad coverage in all the areas (including rural areas).
- Security is enhanced by creating the a direct link with the GPRS service provider.
- Higher speed is recorded as whole system was connected to an IP connection.
- Expenses related to man intervention/purchase of fittings and other devices are reduced.

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VIII. REFERENCES


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