

SMS ALERT SYSTEM AT NSRRC

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Abstract

SMS (Short Message Service) technology has been used extensively today in the wireless world. The Utility Group at NSRRC has developed an SMS alert and notification system with LabVIEW programming language to continuously monitor the critical signals of its utility systems. A short message will be sent immediately to the responsible people in case of critical components failure. Many critical signals in the Instrumentation Division have been included in this system for monitoring. Since its implementation, the maintenance people have been notified many times to restore the faulty system before the accelerator been shutdown or to minimize the damage. The detailed methodology will be presented here.

INTRODUCTION

SMS (Short Message Service) was designed originally for person-to-person messaging service. A sender can use his mobile phone to send a brief text message to a recipient. When the recipient's mobile phone receives the SMS message, he is notified by his mobile phone with a sound or vibrating. The recipient can read the text message immediately or later. Even if the mobile phone is turned off when the sender is sending the message, the recipient can still be notified as soon as he turns on his mobile phone. This will guarantee the delivery of the message within a period of time. Since its invention, with the aid of computer technology, SMS has been used extensively in the wireless world, many information such as news, financial information alert notification, etc. have been sent with SMS. The mobile phone is very popular today among people and is carried by its owner most of the time. This makes SMS very useful. In the recent years some governments such as, US and Dutch, have even adopted it to design an SMS disaster alert system to send GSM short messages to all of the mobile phones in the area where a disaster occurs to warn the people of the danger. Because the SMS technology uses the "push" of information approach which informs the recipient's mobile phone the existence of the new information, thus, it is very useful in delivering alerts and notifications of important events. At present, many manufactures have also developed their own SMS alert system to send immediately an SMS message to the responsible people when their devices are in trouble or some abnormal condition is detected. For a system which consists of devices from many different manufactures, the integration of these manufactures' SMS alert systems is difficult. At the Utility Group of NSRRC the devices and instruments used are also from many different companies. Considering using an SMS alert system to monitor the signals of our critical devices and without using many different types of SMS alert systems, during last year we

designed our own SMS alert system with the signals obtained from different types of devices and equipments. At present, more then one hundred and sixty selected signals are under monitoring with our SMS alert system. In the following sections, the design philosophy is described.

PROGRAM DESIGN

The Architecture of Utility Control System

The infrastructure of utility control system of NSRRC is divided into 5 layers as described in Ref. 1. A brief description is shown here. The bottom two layers are basically hardware layers. The front end IO devices are responsible for acquiring the values of signals and providing some needed setting parameters. The controllers provide the basic machine control functions and communicate with its peer and the upper layers. The data processing layer is responsible for collecting all of the data from the lower layer and uses more complex algorithms for the data processing. It provides important process parameters for the controlled subsystems or devices. A server program is provided in each server PC here to online monitor the signals. Some alert functions are provided here, too. The data service layer provides a robust and reliable storage of the acquired data and server functions for other programs to access the data. In the user level a friendly and flexible interface is used to monitor, compare and analyze all of the available signals.

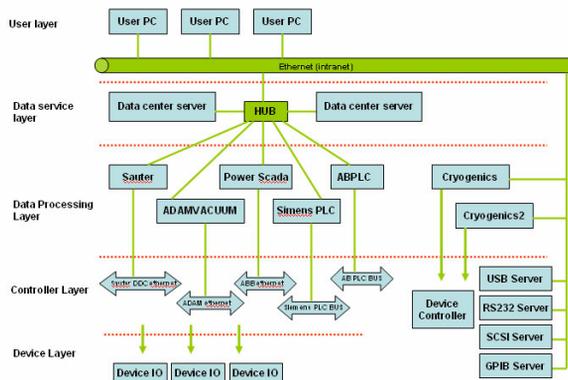


Figure 1: The infrastructure of NSRRC utility control system.

Program Structure

The SMS alert program is designed to be implemented in the data processing layer. This allows to obtain the acquired signal values without going through many wiring and computers. While it is possible to install the SMS alert program for each server PC of each subgroup, we have decided to use a single PC as an SMS server. This server will gather all signal values from the server

PCs of all subgroups. Then, only one single GSM/GPRS modem will be used to send the alert messages.

At present, the NSRRC utility control system has not used any standard database system for the data processing and storage. There are two custom made text files used to serve as the static database and the dynamic database for each subgroup in the data processing layer. One is the file which stored all of the parameters related to the signals. It will be read and used by the processing programs. The other file is used to store the acquired real time signal values and updated every few seconds.

In the SMS alert program, the parameter file and real time data file of each subgroup are obtained with an ftp function. Since all of the real time values of signals are read, we selected firstly the signals which will be used for monitoring in the SMS alert program. The real time values of these signals are compared with the preset higher limit and lower limit which have been set in the parameter file. If the real time value is outside of the limits, a trigger would occur. The loop time is set as 10 seconds at present, even it can be faster. Recently, there is a request to monitor the flow rate of the de-ionized water in order to discover any water leak. Some modifications are made to the program. Due to the characteristics of flow meter used, we need to let the program to store the historical data for a couple of hours in order to do the comparison of data between different times. When the trigger conditions and other preset conditions are met, the messages will be sent to the modem, which will send them to the SMS center. Due to the slow transmission speed of modem, a queue should be used between the trigger loop and the modem loop to prevent the override of the preceding messages by the succeeded messages. A block diagram in Fig. 2 gives a brief description of the program flow. Some screen shots are shown in Fig. 3.

Some Practical Considerations

During the development of our SMS alert system, there are many practical circumstances must be considered. Some major items are described below.

For the software used in our utility control system, beside the commercial packages, computer languages such as Visual Basics, PLC ladder languages, etc. are used. In the recent years we used mainly in the data processing layer and the top layer the National Instruments' LabVIEW programming language. It has a user friendly nature in the programming, especially in the design of GUI panel. We used it to develop SMS alert program.

There are several approaches to send an SMS message from a computer to recipients. The message can be sent from a computer with a mobile phone or a GSM/GPRS modem, or it can be sent from a computer to the SMS center or SMS gateway of a wireless carrier, then, to the recipients. The former has slow transmission speed (about 6 messages per minute), while the later is very fast, but it involves more network wiring and routing. Considering SMS alert messages will only be sent when there are triggers, its traffic will be small in general. In order to send our alert messages from the SMS server with more

reliability, we have selected a GSM/GPRS wireless modem which allows us to use the computer with AT commands to control the modem to send the alert messages directly [2]. The Wavecom's Fastrack modem M1206 was selected for this purpose.

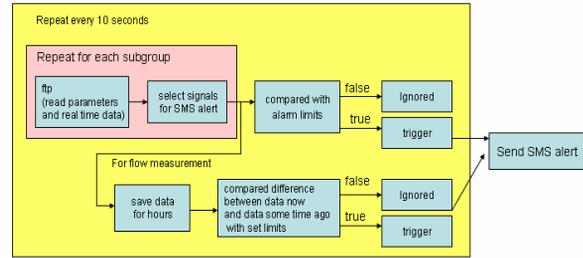


Figure 2: The block diagram of design of SMS alert program.



Figure 3a: The screen shot of SMS alert program.

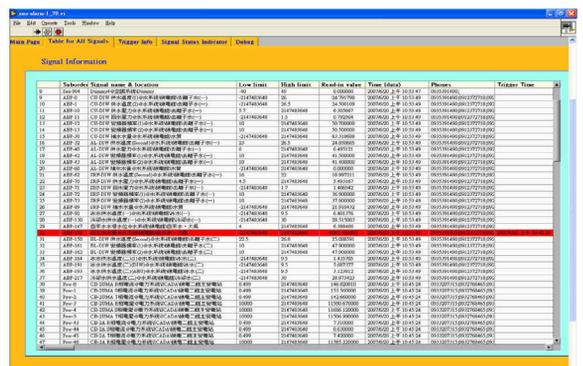


Figure 3b: The screen shot of SMS alert program. The rows in red show that the SMS alert messages are sent to responsible technicians.

One special consideration in our design is that the Chinese characters should be used, because some of our technicians are not comfortable in using English, some of signal names used are in Chinese. For sending the short messages in Chinese characters the programming is more complicated. It turns out that the Wavecom's M1206 modem can be used to send the Chinese characters in the text mode as long as the Chinese characters are converted into unicode first, which simplifies the programming. For sending the Chinese characters in the SMS only 70 characters can be used, rather than 160 characters as that in English. But, it turns out that this is enough for us,

since the abbreviations of Chinese names have much less characters than English names.

To make the SMS alert program in the practical use, we have also considered conditions of how to trigger the sending of SMS alert messages. Some of the signals may be disturbed by the sudden noises, which produces extremely high abnormal values or no value for several acquired data points. Some of our monitors also have slow data acquisition rate, e.g. the thermal sensors can measure only one temperature value at least 30 seconds. From our experience we decided that the SMS alert will be sent only when there are several consecutive triggers. This decision seems to work very well and without producing any false alert message.

Even the SMS message in general will be received as long as the mobile phones of recipients are turned on. We still let the program send the follow-up messages every 2 hours until the faulty devices or errors are fixed and the signal values go back to normal.

When the network connected to the server of subgroups is down or in trouble, the SMS server will receive error value for all signals. The alerts will be sent for all of the signals in that subgroup. Therefore, a function is imposed in the program to judge this situation. Then, only one SMS alert will be sent to the manager of the server to notify him to restore the server or its network.

In some situation, the monitored signal is under repair or a whole subgroup is under maintenance. The signals will give incorrect values. A function is also imposed to temporarily disable the trigger function of this single signal or the whole subgroup.

The SMS alert program has also been imposed a watchdog function to let the manager to know if it is running by sending a message to the manager at some specified time every day.

A web server was also developed to show the real time data of each subgroup to provide auxiliary information. The log file of the SMS alert system can also be viewed remotely. An archive viewer program is also used to obtain the latest archived data of all signals.

The Extension of SMS Alert

When there is a faulty condition in the equipment and the trigger conditions are met, the SMS alert message will be sent to the responsible people immediately. Since these trigger conditions are determined according to the technicians' long time experience, when they read the message, they can determine if they should go to the site to fix the problem right away or take any necessary action. They can also check the associated web page or call the people to help them to solve the problems. A simple block diagram of the action the people who receive the SMS alert messages can take is shown in Fig. 4.

ACCOMPLISHMENT

The SMS alert system has been used about a year at NSRRC. It has proven it as a valuable tool in reducing the

accelerator downtime and minimizing the equipment damages. There were several occasions that one chiller has malfunctioned and the technicians received the alert messages after office hours, they rushed immediately to our utility building to fix the problems within 30 minutes. It prevented the accelerator from been shutdown. Also, the water leak detection function has alerted the technicians about the water leak, so they rushed to the site to fix the problem and prevent a severe damage to the electronics. Some of the signals used in the SMS alert system may report faulty conditions which may still shutdown the accelerator, but it sure to notify immediately the technicians to do the repairs as soon as possible.

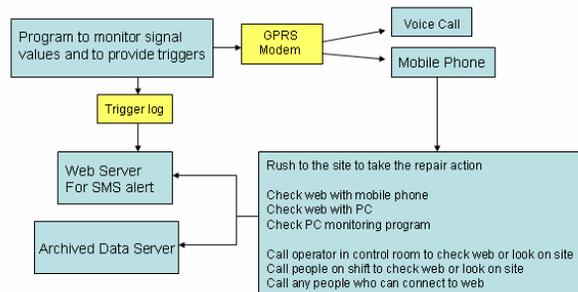


Figure 4: The actions of people who receive the SMS alert messages can take.

FUTURE DEVELOPMENT

At present, we are trying to improve this system to make the program being able to handle more signals. Or, if the processing speed is restricted by the computer, several PCs can be used separately as the SMS servers. In this situation, the signals should be classified with different priorities for different PC's SMS alert program running with different looping speed. Or, the signals in the neighboring locations should use a same server. Also, at present, an ftp function is used to transfer the signal values to the SMS alert server, we are testing the transmission efficiency of shared variables developed by National Instruments. If they are better, we will consider using the shared variables mechanism to replace the ftp program.

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REFERENCES

- [1] Z. D. Tsai, et al., "Monitor and Archive System of Instrumentation", APAC2007, Indore, India, January 2007.
- [2] Wavecom, "AT Commands Interface Guide for AT x41", September 2004, <http://www.wavecom.com>.