SMS ALERT SYSTEM AT NSRRC

T. S. Ueng, Z. D. Tsai, J. C. Chang, NSRRC, Hsinchu, Taiwan

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

06 Instrumentation, Controls, Feedback & Operational Aspects

1-4244-0917-9/07/\$25.00 ©2007 IEEE

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

06 Instrumentation, Controls, Feedback & Operational Aspects

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.

			NSRRC	Utility Center SMS A			
			mercu				
427. 1	itarin birot	and fr	auterly	COMEXCOM2	Convictions	Digned no: exigned	
() in	() N		20	ATTACT CALLS	20036/20	100	
Mak	tion probed	laure la			free free scores at	1202201000	
(1) 120	B 130	0			200746/20	Tigred and some	
				Modem is enabled			
N.	1				Toos data sequend	Dignel moving	
Pri anu	Le.		-		上平11:2417	250	
1000							
the	1015 7/14H	green in chevring			The state of the s		
jiho bor	09/15/2014/40 05/15/2014/40 05/19/95 22/00	great is reaving		Reset	Log filmans a lane log (2)(2) log 22	0706151340 tot	
1.34	en (00.5721480) Minuel 22100	pen ir receing		Reset	ting filmman 1 time to gCHG-log-20	0706151340 be	
y La La Solo	er (0.0529144) Minuel 22.00	gren it receip		Reset	Log thrown (churchg200-log-20	0706151340 pe	
Sala	No man 2 22 00	Username	Password	Resel	Log filmens churchog/202-log/20	Phones	Disal
Saba	0015201480 Minue 2210 TOB 140 110 207 53	Utername Receptoral	Passwood A@A	Resel Realtime Data Path /Dowler/Saster Data da	Leg filmens (classic)(2023/25/25/27) Realiting: List Path (Decates/Sacter List Mi	Phones 093539140.0012372718.05	Disal 38
Subg	Mit 2010 Mit 2010 Mit 2010 Mit 2010 Mit 2010 Mit 2010 Mit 2017 Mit	ринн и гелонуд • • • • • • • • • • • • •	Passwood A@A A@A	Reset	Log times charologCMC-log 22 Readinase Lost Path Drougles/Saster Lost 34 Drougles/ABPLC Lost 36	Phones 091533140 to 09153391490,0912372710,05 0915391490,0912372710,05	Ducal 34 34
Suba D	Distriction Distrest Distriction <t< td=""><td>Urername Acceptions acceptions acceptions</td><td>Passonal a(j)a a(j)a</td><td>Reset</td><td>Log throws cheesing SIG-log 20 Readman List Path Downer: Sister List M Downer: Sister List M Downer: Sister List M</td><td>Phones 0935391400,0912372710,05 0935391400,0912372710,05</td><td>Discal 34 34</td></t<>	Urername Acceptions acceptions acceptions	Passonal a(j)a a(j)a	Reset	Log throws cheesing SIG-log 20 Readman List Path Downer: Sister List M Downer: Sister List M Downer: Sister List M	Phones 0935391400,0912372710,05 0935391400,0912372710,05	Discal 34 34
Suba 0 1 3 4	Bit Strate Bit St	Стетляне ассертова ассертова ассертова ассертова	Passwood Allia Allia Allia	Restinne Data Path Double/State Data M Double/Data State Descent/WPL/D Data M Descent/WPL/D Data M Descent/WPL/DAt/Varian Data M	Log thousa stanolog/SR-log/20 Readmon List Path (Donater/Satter List 3d) (Donater/ADPL/2 List 3d) (Donater/ADPA/2 List 3d) (Donater/ADPA/2 List 3d) (Donater/ADPA/2 List 3d)	Phones 0015394000012372710.05 0015394400.0512372710.05 0015394400.0512372710.05	Dirah 34 14 24
	Image: Distribution Distribution Image: Distribution Image: Distribution Image: Distribution Image: Distribution Image: Distribution Image: Distribution Image: Distribution Image: Distribution Image: Distr	U secume acceptoria acceptoria acceptoria acceptoria acceptoria acceptoria acceptoria acceptoria acceptoria acceptoria acceptoria	Passwood A@A a@A A@A a@a a@a	Readine Data Path Guadraffinder Data de Donater/APLED Data de Donater/APLED Data de Donater/APLED Data de	Log theore is two-bat/DR-bag-20 Readinese List Path Diseases States List 3d Diseases ADV La tat de Diseases ADV Advacuma List Diseases ADVAC Last de	Phones 0033391490,0512372710,05 0033391490,0512372710,05 003391490,0912272710,05 003391490,0912272710,05	Data N H H

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

33	•							
Ta	Ne for All	Signals Trigger Jato Signal States Indicator	Debug					
		Contraction of the second s						
Zigi	al Inform	ation						
			1		1	-	-	
	Saborder	Signal name & location	Low heat	Fogh limit	Read-in value	Time (data)	Phones	Tritter Time
	202.004	Children and a strategy and a set of the	-40	49	0.00000	2007/6/20 2/4 10/57/77	0505391490;	
	1000	CONTRACTOR CONTRACTOR CONTRACTOR OF THE CONTRACTOR OF THE CONTRACTOR CONTRACT	-218760,0980		28.795790	20070020 24 10 13 49	000000000000000000000000000000000000000	
0	ABP-1	CO-DEW BED BLECOWS PARCONNERS (CART 9 ()	1234740,3040	20.5	24,500109	2007/5/20 2/# 10:53 #3		
	A87-22	COLOR PREAMINE AND A REAL PROPERTY (INC.)		2117657000	0.707007	2010/020 24 10:00 49	Contract and Destructure Day	
<u>. </u>	107-11	CODINERT ALL AND A CONTRACT AND A REPORT OF THE AND A REPORT OF THE ADDRESS OF TH	2147403040	13	0.772304	2007/020 24 1033/07	00053914005012372736500	
	488.11	(1) 11日 (1) (1) (1) (1) (1) (1) (1) (1) (1) (1)	10	2147483648	50 500000	20074620 kdt 10.53.49	0011101000001177710000	
-	1 4 100.00	CU DUR LALA BOAT VIRGE AND AND	ALCOND.	Distables.	41 110000	0007400 b.# 10.53.49	00.14 101 100 000 100 100 100	
4	1108.22	ALL THE REAL PROPERTY AND A DESCRIPTION OF A DESCRIPTIONO	122	2011/08/2018	34 (22000	20000000 a 4 10.53.49	000000000000000000000000000000000000000	
<u> </u>	100.43	11 TOW ON A REPORT OF THE REPORT OF THE REPORT OF THE	1	NUCLEUM AND	2 4355555	20000 E PO L # 10 53 43	0031381400.0013.000218.000	
	157.41	ALL TO BE STREET AND A REPORT OF A	10	2147423642	41 500000	200746/00 1:44 10:51 49	0015101400.00011177718.000	
0	ANP.41	A1. TOW SHOW SEX () O'+ 5 (FOR BY	10	2147481648	41.400000	20028-00 1-0 10 51 42	0213/51/50 0212177711-02	
-	4102.00	ALL TO W MENDARIN COMPANY AND ADDRESS OF MET AND	214141403640	1147401640	0.00000	CONTRACTO & 0. 10 57 49	CRUIS PLAATACHER TOTTTE BORT	
	152.07	THE PARTY AND A REPORT OF A PARTY PARTY AND A PARTY.	14	99	18 007311	200734L00 L # 10.51.43	0035384490.0013777318.000	
-	102.20	192.000 00+20 Part 2(2042-000)+2(2042-000)	45	2147423642	Seking	2003600 14 10 51 49	0015361400-0011177718-007	
	4110.71	THE FITTER SPACE THAT IS A REAL PROPERTY OF STATE	2141403040	1.7	1.404047	THEFT & P. 10, 10, 17, 17, 19	(00135 354 A030 0003 3 PT7755 8 000	
<u>.</u>	402.22	FOR THE SEARCE AND ALL AND A REPORT OF BET AND A	10	2147433643	¥ 900000	0007600 E @ 105140	09153514910911177718-092	
15	A82-71	28月10日 安藤岡橋定のホホドは安藤田市ホヨテホ(一)	10	2147483648	17 900000	20024620 1-# 10.53 49	0935391490-0912372718-080	
× -	AD2.00	CONTRACTOR AND	2143403640	0147483648	21.010412	00026-00 F-0 10-51-02	09151514010912177718-097	
2	A52-92	Active:	-2147403688	9.5	6.411226	2007/6/20 1 4 10 53 49	0935391490.0912372718.090	
10	AEP-130	(430+3+3+31 (1))(-)(-)(-)(-)(-)(-)(-)(-)(-)(-)(-)(-)(-	-2147403648	30	20.515003	2007/5/20 上年 10:53 49	0935391490;0912372718;090	
9	A87-147	自至水水堰水拉业水系建设和推建的至水、大菜	4	2147483648	6.389466	2007/6/20 上半 10:53:49	0935391490 0912372718 090	
1	AUT 140	自己のためのためのないのないので、アル	214240348	211745364	9062,003.0	20106430 2:410:53-49	0/0/14/04/17/71106	2016/20 214 33
1	A307-150	HL-LOW IN FORM TO CONCERD OF CONTRACT OF THE CONTRACT OF CONCERNMENT OF CONCERNMENT.	22.5	20.8	25188590	2007/5/20 [+ 10.53 49	05353914903912372718356	
1	407-161	のいため、実施を加まります。中には現在にの親子さ(二)	10	214 7483648	47 500000	2007500 E# 105349	093339149039912372718(99)	
<u> </u>	Aur-192	are and a second of the second s		4141493049	47.300000	annona (# 1055.09	00000000000000000000000000000000000000	
-	107-194	A DEPARTURE CONTRACTOR AND A DEPARTURE AND A DEPARTURA AND A D	214740,0040	9.5	1,425792	2007000 27 1033 43	00033014000012072716000	
<u> </u>	488.191	14 - 15 - 16 - 17 - 16 - 17 - 16 - 17 - 17 - 17	-1147483648	95	1173612	20073600 h # 10.53 #	001535460.0001377718380	
	100.347	The second second second second second second	2147402448	10	20.073423	0003800 b # 10.53.40	0011 101 400 001 3177718 000	
	Ren 0	COLORDAN DATES AND THE ADAY A TAXABLE TO BE A SAMELA	0.410	2147403640	144.000010	000018-500 b (E 10.45-54	000 200 10 500 2700 465 00	
<u>.</u>	Read I	CENTRAL PROPERTY AND THE ADDRESS OF A DAMAGE THE RESIDENCE	0.450	21/7423/42	153 50000	100074100 L-# 1045.24	00120071150012200445001	
<u> </u>	Res. 2	CRATHA DEPENDENCE PROPERTY AND THE ASSESSED.	0.699	2147423642	142 660000	2003600 h/6 104504	00120071+50022268465091	
	Per 1	CHI STIMA ENTRY OF OTH TO MARKET ADALARMET AT A SPECIA	10000	2147481648	11100 620000	200736-200 1-9-10-45-24	00112071110017788861001	
0	Doed	CTU STIMA CASHE DUGINE THE UPON ADALAR THE SAMES	10000	2147433643	11605120000	2007/K/00 E 07 10 45/34	0911007115091730465091	
11	Prop.5	CROTINA THREE OR THREE ADAVAGE THE SHEW	10000	2147483648	11505 990000	20024620 1-# 1045.24	0911207115091276465091	
ii	Prov.41	CO.DA ENTRUMORE PUBLICADA AND THE EXPERIE	0.499	2147485648	7.110000	20026-00 F-0 1045-24	0011202111001228445.001	
15	2mr-44	CD-2A 25000-E OID 718-JP/JCADWERD _ RETSINGLA	0.499	2147433643	0.63000	2007/6/20 1 4 10 45 24	0933207315093276846509	
R.	Boards	CD.24 THER & OR 718 JPCC 4D 4 MAR THE SHOULD	0.422	2147413643	7,420000	20024500 F.W. 104524	0011007115001776465001	
0	200-46	CB-2A FA2機能の使力が使いてADAVA後二級主任性ない	10000	2147483648	11585 220000	2003/6/20 2 4 10:45:24	09332073150932768465093	
-								

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 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

06 Instrumentation, Controls, Feedback & Operational Aspects

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.

ACKNOWLEDGMENT

The authors are appreciated many useful discussions with the members of Utility Group during the development of SMS alert system. Special thanks should give to C. Y. Liu for his assistant in setting up the related hardware.

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.