Development of Remote Monitoring System for Deep Freezer

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Abstract— **Remote Monitoring System of Deep Freezer takes charges of biological microbe or any samples for experiments safely. Compared with system of deep freezer from other manufacturers, deep freezer with remote monitoring system shows time-table of temperature through program LabVIEW™ and saves the data. If deep freezer's temperature is higher than setting degree, it automatically announces this situation to the clerk in charge by text message. Then, the clerk would be possible for monitoring deep freezers through web. If using this system, it's possible to cope with any problems of deep freezer and actualize condition-based maintenance (CBM) through collecting the historical data and analyzing them.**

Keywords— **Deep Freezer, Remote Monitoring, SMS**

I. Introduction

Deep freezer (DF) maintains biological microorganisms (which are virus, rare bacteria, antigen and antibody) and multifarious samples of experiment (which are sera, DNA and RNA) and donation organs to be frozen between -70℃ and -85℃ for long time.

Most of the DFs are kept apart from people because of a lot of noise, temperature of the place to set up and ventilation. So it's challenging time to deal with it when some DFs happen to function-error, even though they belong to alarm function. Moreover, it spends a lot of time to transfer the materials to another DF in proper order after the error happens. Accordingly, it should be necessary to have remote monitoring system.

Some international and domestic manufacturers provide with the system but it's limited not to control all DFs integrated.

To overcome this weak point, each DFs are installed with the same thermal sensor automatically notify the temperature to computer every-minute. Clerks can be monitoring and controlling remotely with the software which is LabVIEW™ from NI-company. Finally, when the temperature is definitely different from criteria, the computer sends an alarm text message to clerks.

II. Diagram for Remote Monitoring System

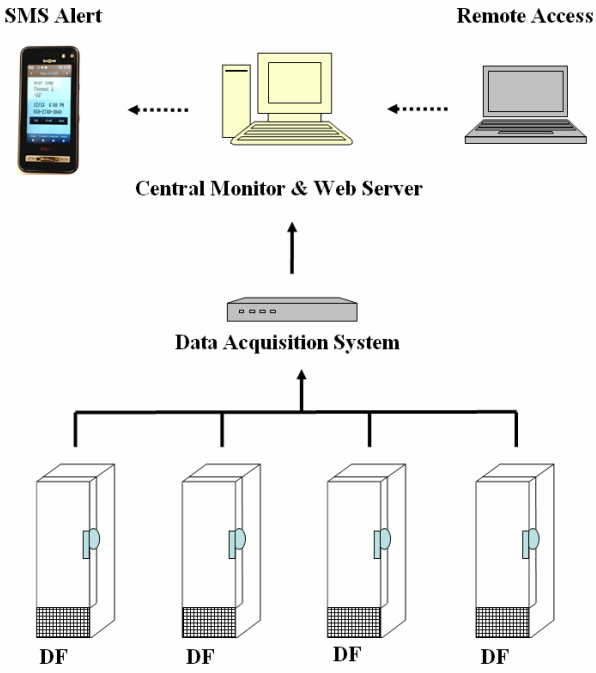

Fig1. System Diagram

III. Sensor System

The circuit for estimating consists of the stable electric current circuit and tiny signal amplification circuit. Temperature sensor is Pt-100. (Fig 2)

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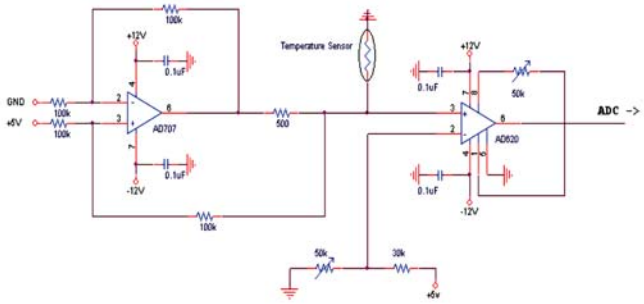

Fig 2. Circuit for Estimating

IV. SHORT MESSAGE SERVICE SYSTEM

Short message service (SMS) system is automatically to send a text message to the specific cellular phone number if the temperature is definitely different from criteria. Clerks will not be able to prepare for the error if this fact does not notify to them even though sensor system works correctly.

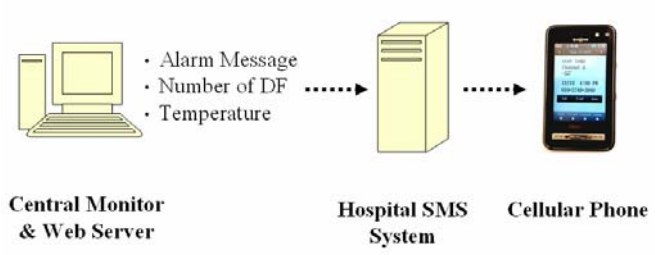

Fig 3. Text message system

SMS system is set up to send a message through hospital SMS service system which is improved by Seoul Asan Medical Center.

V. REMOTE ACCESS AND CONTROL SYSTEM

A recipient who receives a message from text message system is able to monitor current temperature and variation history remotely when inner temperature of DF becomes significant changes compared to criteria. (Picture 4)

Remote access can be possible through web server computer for temperature monitoring Clerks can distinguish temporary change from malfunction owing to this system and deal with it. Also, it's possible to control system through computer

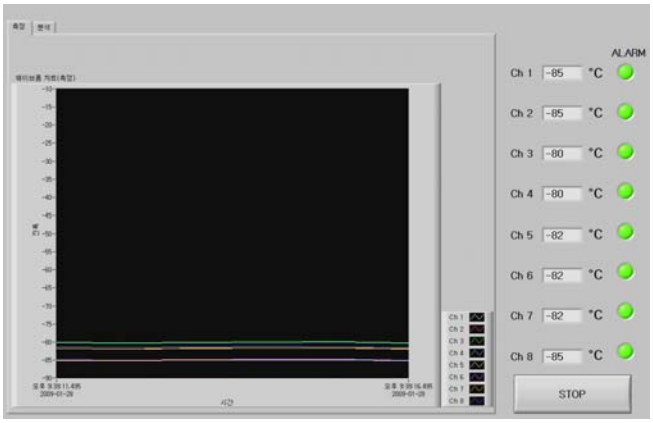

Fig4-1. Display for remote access and control
(normal state)

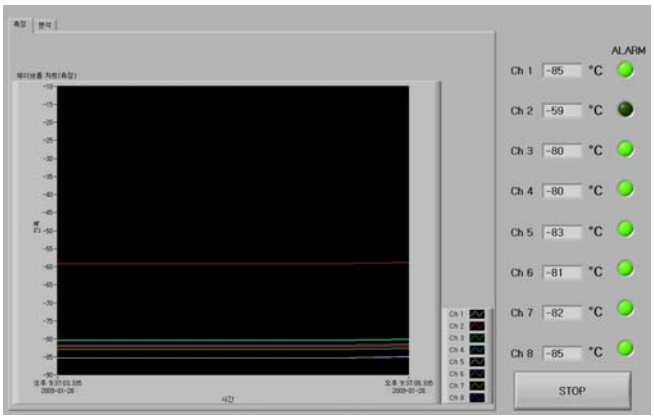

Fig4-2. Display for remote access and control
(abnormal state)

VI. CONCLUSIONS

It is completed to converting estimated data to temperature and then monitoring and sending a text message when temperature is unusual. (Fig 5)

It's possible to monitor in hospital and also outside. It's possible to confirm the conditions of each DF separately.

Fig5. SMS text message

It shows to compare manufacturer system to remote monitoring system below. (Table 1)

Table 1. Comparison

	Developed System	Manufacturer system
SMS	Alarm with details (the number and temperature of DF)	Only alarm
Method of the Remote Access	Web	LAN
Application	All kinds of DF	Restricted for the own DF

VII Experimental Evaluation

In hospital where has a variety of medical machinery, remote monitoring system is very useful and all machinery can be monitored wherever they are located in. Clerks can distinguish temporary change from malfunction owing to this system and deal with it. Moreover, it can be possible to confirm the machinery' ability and prevent from error with observation of temperature change. If it extends to province, it's possible to apply for EO gas sterilizer and infant incubator.

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