Implementation of Moderator Circulation Test Temperature Measurement System

Yeong Muk Lim[a], Seok Boong Hong[a], Min Seok Kim[a], Hwa Rim Choi[a], Hyung Shin Kim[b*]
[a]*Korea Atomic Energy Research Institute, 1045 Daedeok-daero, Yuseong-gu, Daejeon, Korea, 305-353*
[b]*Department of Computer Science and Engineering, Chungnam National University, Daejeon, Korea*
**Corresponding author : hyungshin@cnu.ac.kr*

1. Introduction

Moderator Circulation Test(MCT) facility is 1/4 scale facility designed to reproduce the important characteristics of moderator circulation in a CANDU6 calandria under a range of operating conditions [1]. MCT is an equipment with 380 acrylic pipes instead of the heater rods and a preliminary measurement of velocity field using PIV(Particle Image Velocimetry) is performed under the iso-thermal test conditions [2].

The Korea Atomic Energy Research Institute (KAERI) started implementation of MCT Temperature Measurement System (TMS) using multiple infrared sensors. To control multiple infrared sensors, MCT TMS is implemented using National Instruments (NI) LabVIEW programming language.

2. MCT TMS Environment

The MCT TMS consists of 35 sensor pipes and Data Acquisition System (DAS). The DAS is the data acquisition and display system of NI company. The DAS includes PXI 8431/2 network adapter of a RS-422 communication method. The 35 sensor pipes and The DAS is connected in series.

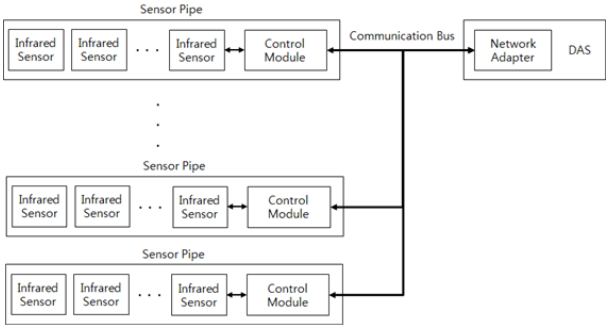

Fig. 1. MCT TMS

The 35 sensor pipes include 395 infrared sensors and 35 control modules on Printed Circuit Board (PCB) as shown in Fig. 1. The PCB circuit are coated with water proof agent in order to prevent leakage. The 35 sensor pipes are installed in the guide pipes of the top in the MCT facility. The 35 sensor pipes are categorized by the number of sensors as shown in Table 1. The 35 sensor pipe consists of a total of 5 sets by 7 types in Table 1 as one set.

Table 1: Sensor pipe category

Sensor Pipe Type	A, A2	B, B2	C, C2	D
Number of Sensor	9	11	13	13

The control module is a module for communication between multiple infrared sensors and network adapter. It is operated thought control commands. The control module used RS-422 communication method. Communication bus is connected by RS-422 8-pin cable between control module and network adapter.

3. Software Design of MCT TMS

A software is designed to measure sensor data of multiple infrared sensors at least measurement cycle 0.2 seconds using the LabVIEW to display on a graph, a table and a drawing.

Prior to design the software, we calculated the data size of multiple infrared sensors to decide baud-rate. According to the control command rules, The first command is the request of sensor measurement and store of all sensors. The second command is the request of the sensor data of each sensor pipe. The last command receive the sensor data of each sensor pipe.

The size of the data used to receive the entire sensor data in accordance with the procedure is a 55,960 bit. The baud-rate is calculated on the basis of 57.6kbps, but we used 115.2kbps more securely so that the data can be entered.

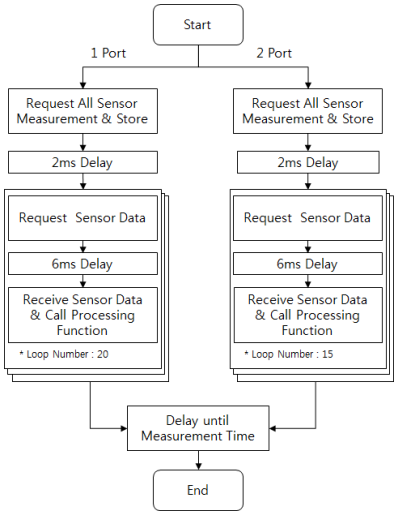

Fig. 2. Collection function

Configuration of the software is largely divided into two parts. The first one is collection function and the second part is processing function. The collection function is composed by the control command rule described above. Important thing is appended the delay time during the control module operation. The first request command is sent and a 2ms delay and second command is sent and a 6ms delay. When the 35 sensor pipes to be processed are at a port they can't meet the minimum measurement time of 0.2 seconds. So we divided the 35 sensor pipes group into 2 ports that is 20 and 15. The collection function flow is shown in Fig.2.

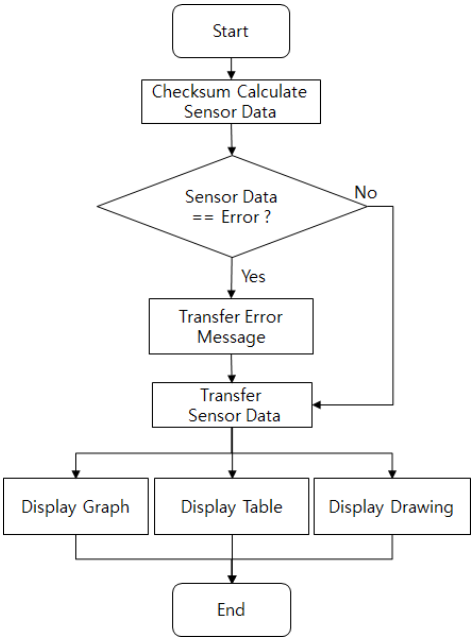

Fig. 3. Processing function

The processing function is constructed using a checksum calculation and the error check of received sensor data. Sensor data processing is completed, is separated by a set, type unit in graphs, tables and drawings. The processing function flow is shown in Fig.3.

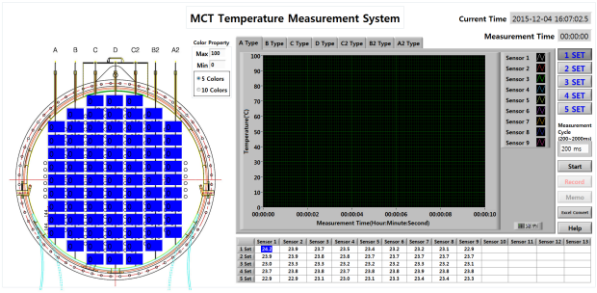

Fig. 4. GUI screen of MCT TMS

Graphic User Interface (GUI) screen of MCT TMS is composed of a graph, a table and a drawing. In addition, the user can confirm the GUI screen to select a set and type of sensor pipe. Sensor data is measured according to the measurement cycle. And sensor data measured is recorded by lvm file type. Lvm file is supported by LabVIEW. Also users can convert lvm file to Excel file. GUI screen of MCT TMS is shown in Fig. 4.

4. Conclusions

The MCT TMS is implemented to measure sensor data of multiple infrared sensors using the LabVIEW. The 35 sensor pipes of MCT TMS are divided into 2 ports to meet the minimum measurement time of 0.2 seconds. The software of MCT TMS is designed using collection function and processing function. The MCT TMS has the function of monitoring the states of multiple infrared sensors. The GUI screen of MCT TMS is composed of sensor pipe categories for user.

This paper can be used to control multiple sensors or devices. Also this results can be used to study thermal hydraulic power related research work.

REFERENCES

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