MICROCONTROLLER BASED DAQ SYSTEM FOR IR THERMOGRAPHY BY HOT AND COLD WATER FLOW

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Abstract:

There are many Non Destructive Technique used in science and industry to evaluate the properties of a material, component or system without causing damage. Infrared Thermography (IR) is one of them. Different types of IR thermograph is used for different purpose. We are using hot and cold-water flow IR Thermography method to evaluate the Performance of Plasma Facing Components (PFC) for Divertor Mock-up[1].

The Set-up is designed in such a way that hot and Called Water can flow in both direction inside mock-up, like left to right and right to Left using electric water pump. Eight numbers of Solenoid Valves have been used for selection of Water Flow Direction, thermo-couples for temperature measurement of water, IR camera to take the images and many others devices. Which needs a very good and versatile DAC system. We have developed a DAC system using micro controller and LabView for the acquisition of various parameters and controlling & synchronization of other system. Development of DAC is described in this paper.

Introduction:

The main aim of this IR thermography is to evaluate the quality of the braze joints between PFC tiles and the copper alloy (CuCrZr) heat sink. Figure-1 shows the schematic of PFC test mock-up and experimental arrangement for IR-NDT. PFC is placed in front of IR camera at a particular distance such that the FOV (Field of View) of IR camera can cover array of tiles. The IR camera captures thermal evolution at the tile surface and transfer these information to the computer for data storage and further processing. We have developed a IR thermography set-up to test the PFC components by Hot and cold water flow method. DAQ system for hot and cold water IR thermography is developed by using micro-controller 8051 and LabView.

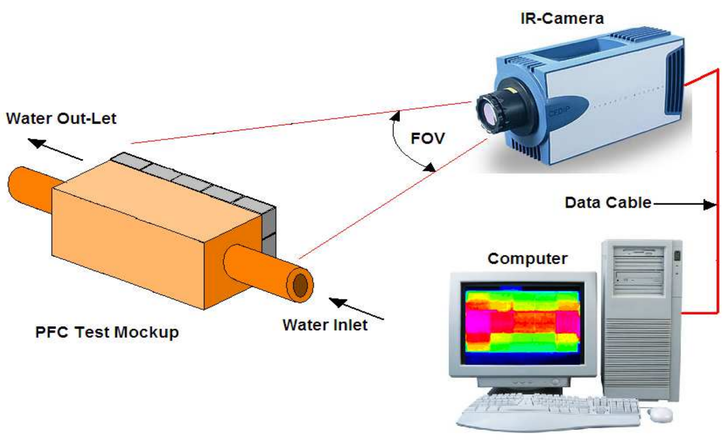

Figure 1: Schematic of IR-Thermography

Hot & Cold Water Flow Loop Set-up For IR-NDT of PFC'S:

A schematic diagram of water flow loop facility to be developed for IR-NDT of PFCs is given in the figure-2. The setup is designed in such a way that hot as well as cold water can flow in both direction inside PFCs, like Left to Right and Right to Left. Eight numbers of water valves have been used for selection of hot & cold water and to alter their flow directions. Flow rate is controlled by VFD.. Four numbers of thermocouples are used to monitor the temperature of water at various locations. Table-1 shows the selection procedures for Hot & Cold water and their flow directions.

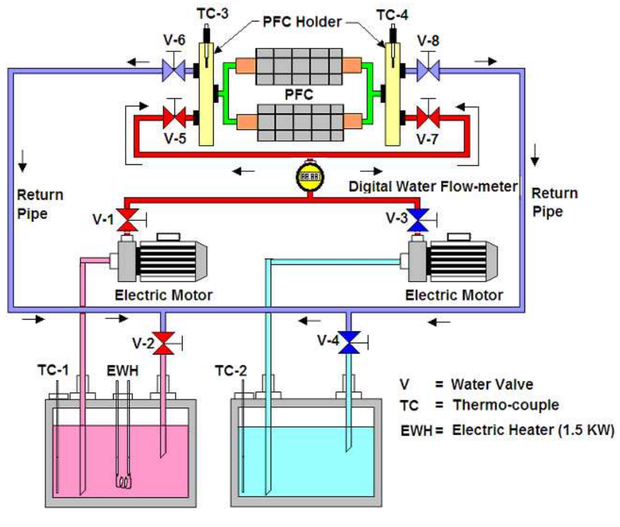

Figure 2 Hot and Cold water flow loop setup

Block Diagram of DAQ

Block diagram of micro controller based DAQ System is shown in figure 3. We have used microprocessor 8051. Serial communication RS-232 is used between PC and micro controller. Solenoid driver circuit is used to operate the solenoid valves. Variable frequency driver is used to run the water pumps at different pressure require for IR thermo-graphy. A signal is given to VFD from micro controller to operate the water pump same signal is also applied to IR camera to store the images. A flow chart is shown in figure 4.

Table 1: Selection of Hot & Cold water and their flow direction

S.N.	Selection of Hot/Cold Water	Direction	Open Valves	Close valves
1	Hot	Right to Left	1,7,6,2	3,5,8,4
		Left to Right	1,5,8,2	3,7,6,4
2	Cold	Right to Left	3,7,6,4	1,5,8,2
		Left to Right	3,5,8,4	1,7,6,2

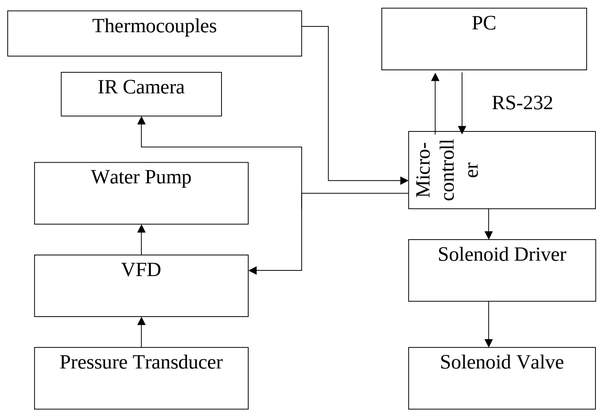

Figure- 3 Block diagram of microcontroller based DAQ system

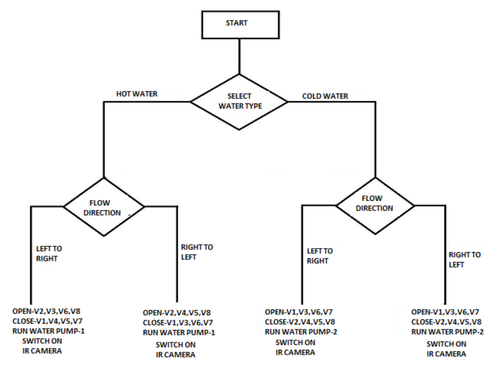

Figure- 4 Flow Chart

Circuit Diagram:

Circuit diagram of DAQ system using micro controller P89V51RD2 is shown in figure 5. Port P1 is used to control the solenoids, water pumps and hot & cold conditions. MAX 232 IC is used for the serial communication with the PC.

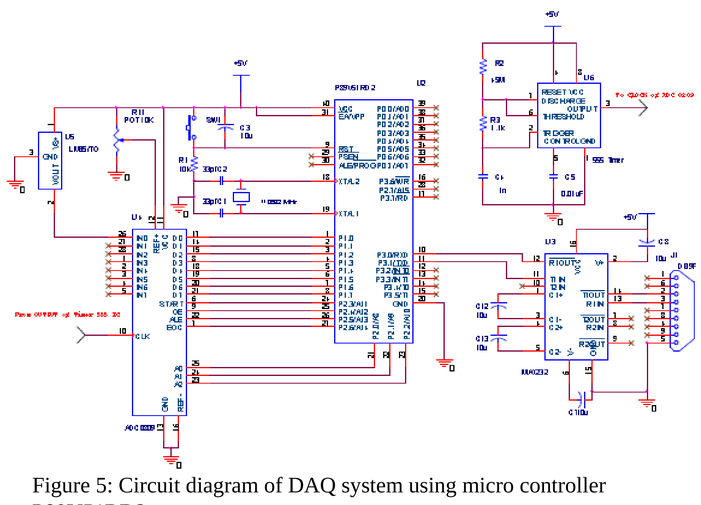

Figure 5: Circuit diagram of DAQ system using micro controller P89V51RD2

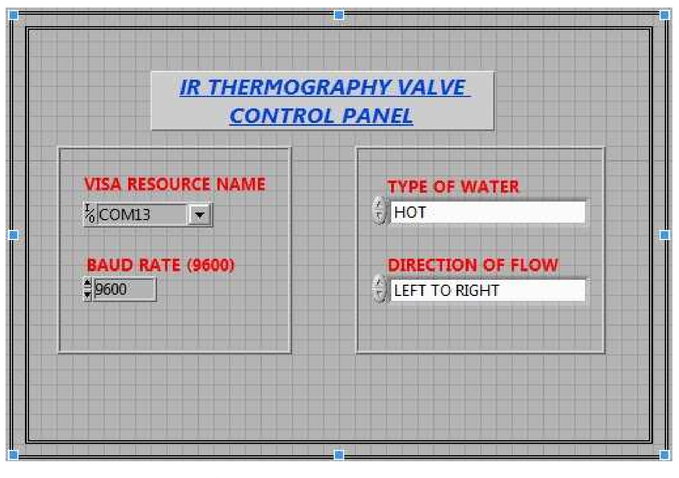

Figure 6: Front panel

User Interface:

We have developed the user interface using LabView 2011. Front panel of the LabView is shown in figure 6. First we have to select between right and left, after that we have to select between hot and cold.

LabView Code:

We have developed LabView code for four conditions. Two for cold water flow and two for hot water flow. For each hot and cold water again divided in two parts. One is for left to write flow and second is for right to left flow. One of the LabView code is shown in figure 7.

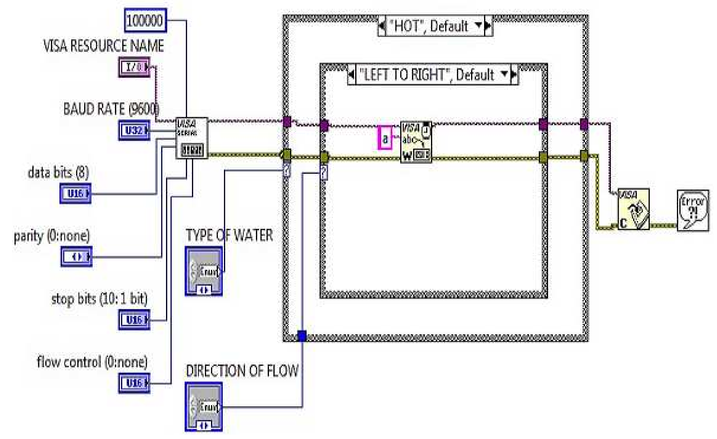

Figure7: LavView code for hot water, left to right flow

Hardware Set-up:

Hardware circuit is shown in figure 8. We have tested the circuit using LED in place of solenoid and water pumps. Now we will integrate the circuit with the electrical control panel.

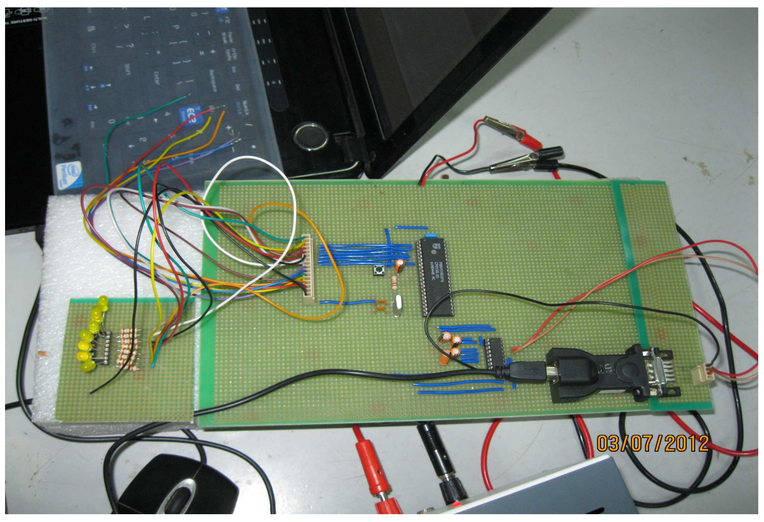

Figure 8: Hardware circuit on general purpose PCB

Figure 9: Electrical control panel

Electrical Control Panel of Hot and Cold water Circulation system:

Hot and cold water system electrical panel is shown in figure 9. We will use the developed DAQ system in such a way that we can operate the system for the control panel as well as from the PC remotely.

Result:

We have successfully implemented and tested the hardware circuit on a general-purpose board. At present we have tested it with LED in place of solenoid valve and motors. Now we will integrate it with the electrical control panel.

Reference:

1. A.Durocher, R.Mitteau, V.Paulus, J.Schlosser, Interface Quality Control by Infrared Thermography Measurement Association Euratom-CEA, Département de Recherches sur la Fusion Contrôlée, CEA/Cadarache