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DEVELOPMENT OF INSTRUMENTATION AND CONTROL SYSTEM AT CREEP MACHINE USING LABVIEW SOFTWARE

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ABSTRACT

DEVELOPMENT OF INSTRUMENTATION AND CONTROL SYSTEM AT CREEP MACHINE USING LABVIEW SOFTWARE. Creep machine on Mechanical Test Facility Laboratory (FUM) BPFKR is an important test tool that one of its functions is to predict the remaining life a component of the installation of nuclear power plants. This estimated life expectancy can be done by studying the characteristics of the elongation properties of the component material to the pressure or load on it at high temperatures (40% of the melting point). For operating temperature determination, this is still done manually, either during calibration or at the time of setting. The integration of this temperature control system in the computerized developed control system is needed to improve the system performance. The purpose of this integration is to simplify and improve the efficiency of data acquisition and time efficiency so that further research can be more easily done. The research methodology used consists of four stages. The first stage is study the existing creeps design and parameters. The second step is to determine the parameters which will be controlled to facilitate further processing. The third stage is determining the electronic module to be used in signal processing used. The modules are Ni 9074, Ni 9213 and Ni 9476. The last step is to create a data acquisition system by assembling the selected modules with the Lab VIEW software. The results of this activity is an easier control system, integrated data processing which has an error rate of 0.04%, then in the future processing of data and further control will be easier.

Keywords: C*reep machine, LabVIEW, Temperature control.*

ABSTRAK

PENGEMBANGAN SISTEM INSTRUMENTASI DAN KENDALI PADA MESIN CREEP MENGGUNAKAN PERANGKAT LUNAK LABVIEW. *Mesin creep pada Fasilitas Uji Mekanik (FUM) BPFKR merupakan alat uji penting yang salah satu fungsinya adalah memperkirakan sisa umur suatu komponen pada instalasi PLTN. Perkiraan sisa umur ini dilakukan dengan mempelajari karakteristik sifat mulur dari komponen bahan tersebut terhadap tekanan atau beban yang mengenainya pada temperatur tinggi (40% dari titik leburnya). Untuk penetapan temperatur operasi, saat ini masih dilakukan secara manual, baik pada saat kalibrasi maupun pada saat penyetelan. Untuk meningkatkan kinerja sistem, dilakukan pengintegrasian kendali temperatur pada sistem kendali yang akan dikembangkan. Tujuannya adalah untuk meningkatkan efisiensi, baik efisiensi akuisisi data maupun efisiensi waktu. Sehingga penelitian lebih lanjut bisa lebih mudah dilakukan. Metodologi penelitian yang digunakan adalah pertama mempelajari desain dan parameter-parameter yang ada pada mesin creep. Langkah kedua menentukan parameter yang akan dikendalikan untuk mempermudah pengolahan lebih lanjut. Langkah ketiga adalah menentukan modul elektronik yang digunakan. Modul ini berupa modul Ni 9074, modul Ni 9213 dan modul Ni 9476. Langkah terakhir adalah membuat sistem akuisisi data dengan merangkai modul-modul tersebut diatas beserta perangkat lunak labVIEW. Hasil dari kegiatan ini adalah berupa sistem kendali, pengolahan data yang terintegrasi yang mempunyai tingkat kesalahan sebesar 0,04% dan lebih mudah digunakan dari pada sebelumnya, sehingga pengolahan data dan kendali lebih lanjut menjadi lebih mudah.*

Kata kunci: Mesin Creep, LabVIEW, Kendali temperatur.

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INTRODUCTION

Creep is defined as a time-dependent stretch. The elongation occurs as a result of slow deformation of a material that acting under constant load at high temperature conditions. The Creep can occur at various temperatures. but the ideal range occurs at temperatures between 40% to 60% of the material melting point [1].

Along with the current technological developments, various equipment have been designed in digital systems with various facilities and conveniences. However, due to technical and economic considerations, many analog devices are still use today. One of the many equipment at mechanical test laboratory facilities is a Creep machine test. This Creep testing machine is used to determine the resistance of a material to a certain load and temperature conditions simultaneously.

With this the existing system, the utilization of the machine is less and many obstacles encountered in the usage and as the development of the need of automatization [2,3]. To overcome these problems development of a digital data acquisition system on the creep machine (analog) is needed [4,5,6].

The integration of the temperature control into a single instrumentation control is carried out both in the hardware and the software. The advantages gained from this system include the usage of the creep engine is more optimal. and allows to set the desired operating temperature be integrated through a PC Computer. The result of this instrumentation and control system development activities is to make the easier temperature control system which associated with the creep machine tool.

Ni 9074 Module

This module is the main input-output module that produced by the National Instruments. The relationship between the modules must be in accordance with the specifications of each module [3]. This module consists of 7 slots which each slot can be accessed on its own as shown in Figure 1.

Figure 1. Ni 9074 Module [7]

Ni 9213 Module

This module is a signal conditioning as well as reinforcement. The thermocouples that can be installed in this module are type J, K, T, E, N, B, R and S. This module has 16 channels. In this activity, the Ni 9213 module receives input signals originating from K type thermocouple sensors which having a measurement range of -200 °C to 1250 °C [4]. The shape of this module can be seen in Figure 2.

Figure 2. Ni 9213 Module [8]

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Ni 9476 Module

This module is an interface module used for a digital signal control or an on-off signal. This module has 32 channels and operates at a maximum voltage of 24 Volts. This module can be seen in Figure 3.

Figure 3. Ni 9476 Module [9]

Configuration of the connection to Ni 9476 module to device such as Solid State Relay (SSR) and power supply can be seen in Figure 4.

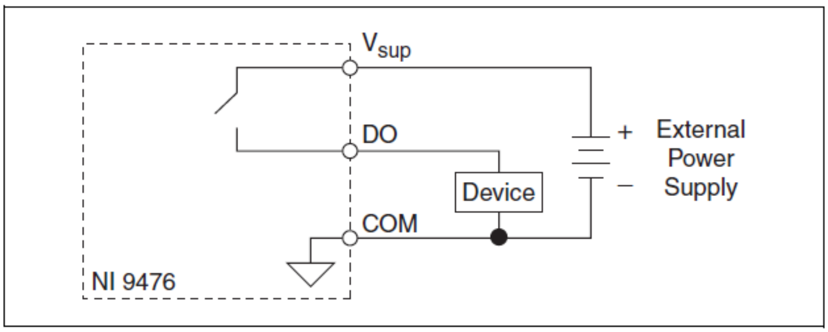

Figure 4. Configuration of the output pin on Ni 9476 to device [9]

Solid State Relay (SSR)

Solid State Relay (SSR) is an electronic switch-which has no mechanically moving parts. Some types of SSRs include photo-coupled SSRs and coupled transformers SSR. A photo is incorporated SSR and controlled by optically isolated low voltage signals from the load. The control signal in an image usually associated with an SSR is a led that activates a photo diode to activate the load. One example of SSR can be seen in Figure 5.

Figure 5. Solid State Relay

METHODOLOGY

The first stage is to study the specifications of the modules and materials to be used. After all modules and materials are ready then the second stage is to assemble the modules and materials according to the thermocouple specifications and functions the digital output input module, the power supply, the solid state relay and the K-type thermocouple sensor temperature. The next stage is to make the driver program using the 2011 LabVIEW version software. The last step is verification and calibration, when the measurement results are compared to the setting or standard values. Furhermore. correlation and correction factor are identified. The configuration of the control system and instrumentation can be shown in Figure 6.

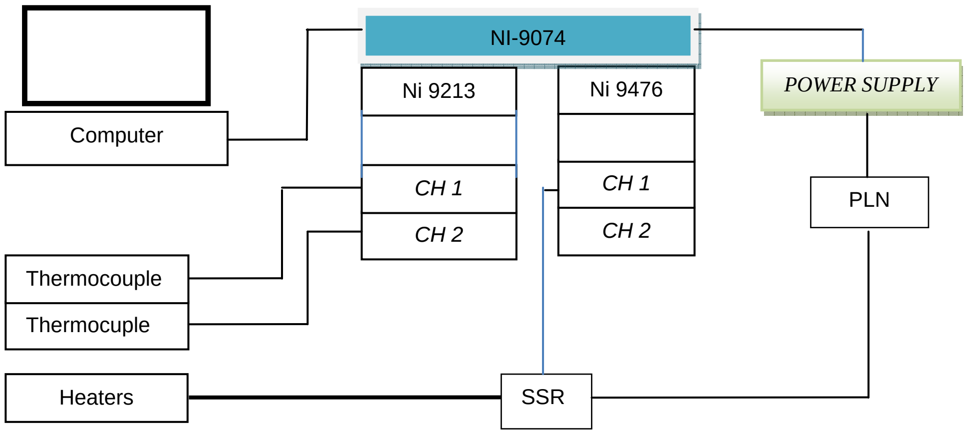

Figure 6. Block diagram control and instrumentation system [10]

RESULTS AND DISCUSSION

Each creep testing machine in the laboratory of Mechanical Testing Facility (FUM) contains two thermocouples of K type. The operating range of this thermocouple is -200 °C to 1.250 °C. While the NI 9476 module is a digital I / O module and functions as a switch. This switch will operate when the signal coming from the creep test machine becomes larger or smaller than the specified signal. In general, temperature control is carried out by this module as follows. the input signal of NI 9476 module is true or false digital quantity (T / F). This signal comes from a comparison operation between the signals coming from the thermocouple sensor with a predetermined value (setting). The output of this module depends on the input configuration. The output value of T or F. T means the output of this module will trigger SSR (Solid State Relay) to turn the heater on or off.

The results of automation and control testing by integrating temperature control on PC computer can be seen in Table 1.

Table 1. The results of the experiment

Setting(°C)	T1(°C)	T2(°C)	T3(°C)	T4(°C)	T5(°C)	Mean(°C)
100	100.050	100.010	100.000	100.124	100.045	100.046
125	124.500	125.050	124.890	125.011	124.098	124.710
150	149.560	150.010	150.000	149.898	150.045	149.903
175	175.000	175.023	174.963	174.785	174.729	174.900
200	200.000	200.023	199.963	199.672	199.729	199.878
225	224.060	225.023	224.963	224.559	224.729	224.667
250	251.000	250.023	249.963	249.446	249.729	250.032
275	275.226	275.023	274.963	274.333	274.729	274.855
300	300.312	300.023	299.963	299.220	299.729	299.850

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325	325.398	325.023	324.963	324.107	324.729	324.844
350	350.484	350.023	349.963	348.994	349.729	349.839
375	375.570	375.023	374.963	373.881	374.729	374.833
400	400.656	400.023	399.963	398.768	399.729	399.828
425	425.742	425.023	424.963	423.655	424.729	424.823
450	450.828	450.023	449.963	448.542	449.729	449.817
475	475.914	475.023	474.963	473.429	474.729	474.812
500	501.000	500.023	499.963	498.316	499.729	499.806
525	526.086	525.023	524.963	523.203	524.729	524.801
550	551.173	550.023	549.963	548.090	549.729	549.796
575	576.259	575.023	574.963	572.977	574.729	574.790
600	601.345	600.023	599.963	597.864	599.729	599.785

The result in Graphic can be shown in Figure 7.

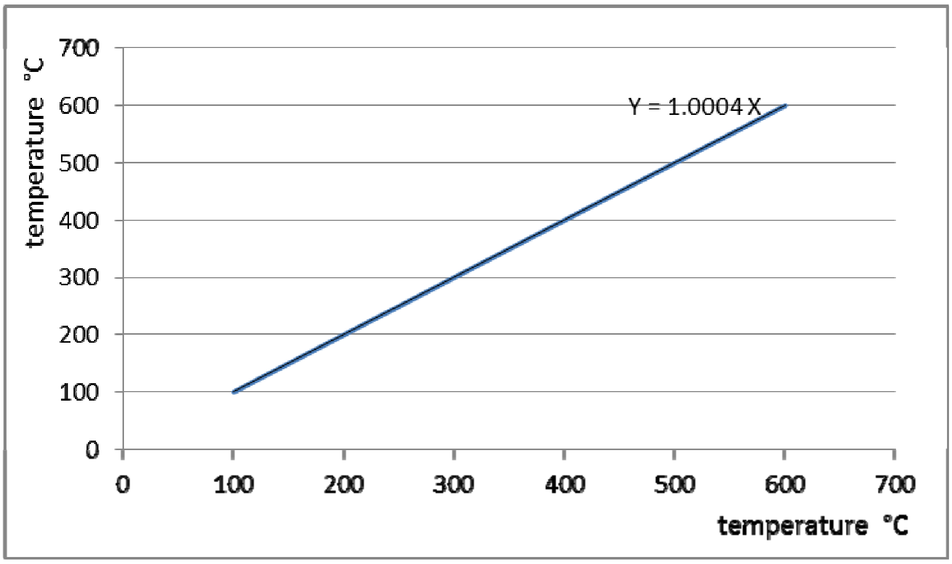

Figure 7. The results of the experiment

Figure 7 showed the relationship of the temperature setting with the temperature of achievement on the creep test machine. The result of this calculation is a linear equation line with a slope of 1. 0004 showed in Line Y = 1.0004X. Where X is the setting temperature and Y is the experiment result temperature at the creep test machine. In other words the error is 0.04%. For experimental function test will be done on the next research.

CONCLUSION

From the result and discussion it can be concluded that by integrating temperature control through PC Computer obtained error value equal to 0.04%. So that the development of instrumentation and control system using LabVIEW software can be used as it should be. To test the actual experiment function will be done on next research next year.

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