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Interfacing PXI System with LabVIEW Program for Event Control and Data Acquisition of Physical Variables Involved in Testing an Engine

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***Abstract* –During testing an engine, PLC(Programmable Logic controller) hardware event monitoring systems are used for continuous recording of command and valve status of the system which is implemented with assembly language program. For further augmentation it is very difficult to modify the coding and the software modules are absolute with frequent failure in hardware equipment used. The main aim of this work is to replace the old system with the state of art PXI (PCI Extension Instrumentation) and to develop for control and acquisition data providing necessary conditions for testing an engine and it permits user to give the inputs necessary to the realization of the test with safety and accuracy measurements for attainment of reliable results. The data acquisition of test stand is done automatically through LabVIEW software. The test stand program will be readable, scalable and leads to secure transmission of the data.**

***Keywords* – Event monitoring, Data acquisition, PXI(PCI Extension Instrumentation), Accuracy measurement, Secure transmission.**

I. INTRODUCTION

Computer based digital data acquisition system (DAS) are used to measure physical variables such as pressure, temperature, flow and level. With such systems the input measure is first converted into an electrical parameter such as resistance, voltage or current using a sensor. The sensor's output which is usually analog is the input to the data acquisition system where it is conditioned and converted to a digital word that is proportional to the analog signal. The digital word is then transmitted to a computer where conversion to engineering units and analysis/display functions are performed.

DAS used nowadays are primarily multi-channel systems. That is, up to N sensors are connected to a single DAS, where they share time among common equipment. These measurement systems are referred to as multiplexed data acquisition systems. Depending on the extent of shared equipment, these are categorised as amplifier per channel system (or) low-level multiplexed systems. While testing an engine, field events like electro pneumatic valve on/off commands, open/close status and engine valve events are to be acquired for online monitoring and offline performance evaluation. The event parameter are in discrete from bit level and are acquired in a byte level method. The acquired data are stored in local hard disk in an append mode and are also transmitted to the server in a overwrite mode. Complete critical requirements are implemented using PXI based data acquisition system hardware. PXI data acquisition hardware can house 14 numbers of functional digital input cards. Application programs required for accessing the cards and processing the events are developed using Linux based platform through C language. The complete system is interfaced along with main network through Ethernet interface (100 MPS).

II. RELATED WORK

A. Introduction

Literature survey is carried out by analyzing many papers relevant to unreachability problem likehigh cost, additional hardware interface, slow sampling rate and limited channel capacity. The researches carried out by different authors are surveyed and the analysis done by the researchers are discussed in the following paragraphs.

B. A Control And Data Acquisition System Based On The Pxi Bus For The New Photon Beam Position Monitor Prototype

A. Galimberti[1] ,M. Appolonio[2], SincrotroneTrieste[3], proposed that usually, in large experimental physics facilities, systems based on the VME bus, are widely used both for the lower level of the control system and for data acquisition. It is common to use this environment also for those applications that do not really need its features. The PXI bus is an industrial extension of the well-known PCI bus used in the desktop computer industry. It may represent a less expensive alternative platform for controlling a complex experimental set-up increasing also the system performances. The development of a new generation of diagnostic detectors at Elettra allows investigating this opportunity. The design

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of its control and data acquisition system is based on the PXI bus and it is fully described in the paper. The benefits and the inconveniences of this platform are then discussed. Besides real-time applications, based on a commercial DSP board, are also discussed with their integration in the PXI system.

C. Developing a Data Acquisition and Control System for a Trisonic Wind Tunnel

Praveen Baburao[1] - Captronic Systems Private Limited Temin Sam Dalton[2] proposed that Wind tunnels are an important testing tool for ground-based aerodynamics studies for aircraft and other moving objects. A large wind tunnel facility required a solution for automated control of the various operations of one of its wind tunnels. This tunnel was a trisonic 0.3 m wind tunnel for testing in subsonic, transonic, and supersonic modes. Reaching the desired MACH number within two seconds was one of the system's key objectives. During the test runs, various interlocks had to be addressed to prevent accidents. Once the MACH number was achieved, the model under test was subjected to a range of linear and angular movements. The data acquisition system recorded important data through sensors mounted on the model.

The system controls the operation of the isolation valve (IV), pressure regulating valve (PRV), model incidence (MI), transonic model craft (TMC), and second throat flaps to ensure accurate and efficient control of the wind tunnel. The tests can run in three modes—subsonic, transonic, and supersonic. The tunnel operation can be further executed in three modes—auto, semiauto, and diagnostic/manual. The air is stored in a reservoir with high pressure, and the isolation valve supplies this air to the tunnel. The isolation valve is operated through the digital output (DO) of the NI module. The percentage of opening of the PRV valve (AO) is based PXI-6514 on the MACH number that needs to be achieved and is implemented using a proportional integral derivative (PID) loop. The stagnation pressure (P0) and the percentage of valve opening are read as analog inputs via a Druck transducer for PID control. The static pressure (Ps) is measured from the settling chamber as analog input using the Druck transducer. The MACH number is then calculated as the ratio of P0 to Ps. The TMC section and second throat section are used to vary the position of the vertical and horizontal control flaps, which helps the user achieve the MACH number accurately. These control flaps are also the analog inputs read from the potentiometer. All analog inputs are acquired using an NI M Series PXI-6224 multifunction DAQ module at high sampling rates. To control the PID loop, TMC, and second throat position analog outputs, an NI high-speed analog input module is used. The model incidence section is the critical section where the position and PXI-6713 the angle of the model are varied per the user configuration. This is accomplished using the hydraulic pressure, which is controlled by proportional valves, which are in turn controlled by analog outputs. During this, strain acting on the model is captured from various points at higher sampling rates using an NI simultaneous bridge input module. All the PXIe-4330 interlocks are handled using the digital I/O of the NI PXI-6514 module. The complete test can run for a maximum of 300 seconds. Separate mimic displays, provided with the touch panel monitor display, depict the actual flow of the tunnel.

III. DESCRIPTION

While testing the engine , field events like electro pneumatic valve, on /off commands open/close status and the engine valve eventsare to be acquired for online monitoring and offline performance evaluation.The event parameter are in discrete form (bit level) and are acquired in a byte level method.The acquired data stored in a local disc in an append mode and are also transmitted to the server in a overwrite mode.Complete critical requirement are implemented using PXI based data acquisition system hardware.PXI data acquistion hardware can house 14 numbers of functional digital input cards. Application programs required for accessing the cards and processing the events are developed using linux based platforms through C language. The complete system is interface along with im

This project mainly deals about engine testing facility using PXI used acquisition hardware with flexible DAS software for acquistion and event processing software for offline analysis. The PXI based DAS is an advanced data acquisition based on the 32-bit PCI architecture.High performance design and state of the art technology make this card ideal for data logging and signal analysis application in instrumentation, process control etc. Complete software module are developed with C programming language that allows linking to a shared library for LINUX.

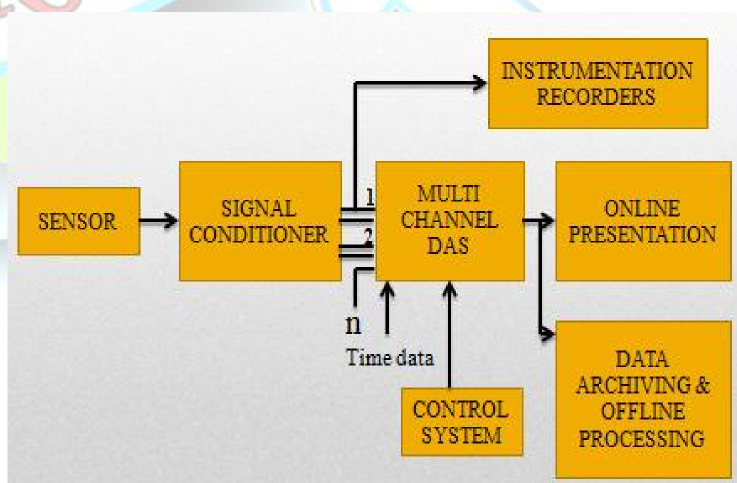

Fig:Block diagram of the system

A. PXI Architecture

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Here PXI 7433 card is used to acquire the field events software modules are developed to acquire various engine field parameter like valve open/close status ,ON/OFF command and other electrical signals, etc these readings are recorded in the local host and also transmitted to the server after completion of the text, the event recorded data are processed to verify the various status of the valve and to verify the response changes occurred during engine. The ultimate aim of the project is to have remote monitoring and logging of field events. The program is developed to transmitted the data to various clients using Ethernet cables and switching system. The data is transmitted in about 100Mbps.The system is implemented with Arcnet and NEFF is implemented with IEEE 488 communication protocol. Data of the Arcnet is 2.5 Mbps and IEEE488 is with moderate speed(1Mbps). The Arcnet is of low speed. The architecture contain in a information to allow as to write the program for each layer as to correctly obey the appropriate protocol. Both Arcnet and IEEE 488 as the following disadvantages[1] high cost [2] Arcnet/IEEE 488 communication requires additional hardware interface [3] slow sampling rate [4] limited channel capacity [5] upgradation and augmentation of card is difficult [6] windows operating system used for data handling are unstable.

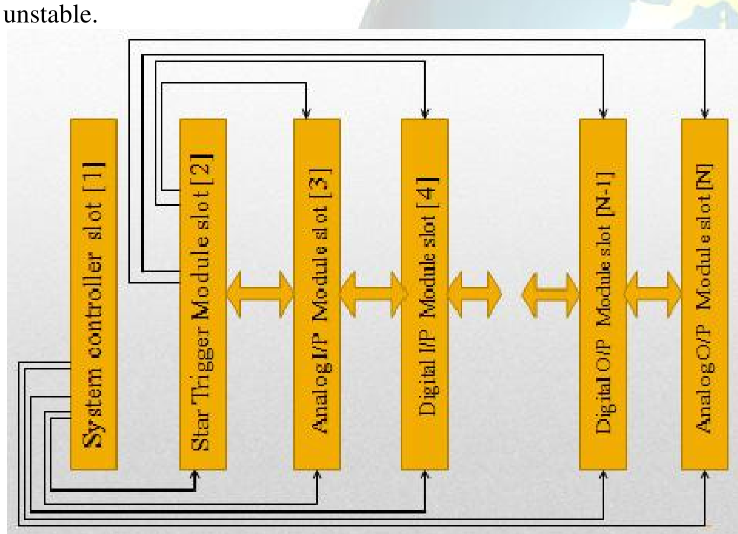

Fig: PXI Architecture

B. System Analysis

The command system consist of mimic console, a Programmable Logic Controller(PLC) for conducting the test using auto sequence, relay racks, analog isolator, zener barrier, DPM (Digital Panel Meter), E/P valve, power supply units, transmitter chains, threshold detector and digital data logger to status signal. The mimic console consist of graphic scheme of fluid circuits with command switches & status indicator of valve at appropriate places. Operation of electro pneumatic valves (E/P valves) remotely in both mannual and automatic node for test preparation and execution of tests can be done manually and issuing command through PLC. PLC is used for test article protection. The system has a modes of operation.

IV. RESULT ANALYSIS

The digital isolated input/output card is executed in the LINUX environment with a series of command in the system terminal window.

root@localhost: r/sample/d2k_dask_A/1sample/7433s
----------------------------Configure cards----------------------------------   card type cards Buffer size[unit pages(4kb/pay)]   A1 A0 D1 D0
(1) DAQ 2010 (2) DAQ 2205 (3) DAQ 2204   (6) DAQ 2207 (5) DAQ 2208 (6) DAQ 2206

Fig: Execution of digital card

After the execution of the command the output of the card is obtained as 0xff from the input 0x0.

Output
PCI-7433 DI samples: The data from DI are shown in the following table:
DI low port input = 0x0   DI high port input = 0x0
Press enter to stop......   0xff   0xff

Fig: Output of digital card

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