International Journal of Electronics Communication and Computer Engineering
Volume 4, Issue 1, ISSN (Online): 2249–071X, ISSN (Print): 2278–4209

Development of Master Chamber Software for Data Acquisition of Ionization Chamber for Indus 2 RRCAT

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***Abstract* – The main goal of this paper was to Develop Master control software for DAQ of ionization chamber for INDUS-2 beam lines for detection of X-ray flux by an Ionization chamber that will remotely control and monitor the ultra low current signal detection analog module precisely. This application will be useful to measure the intensity of X-ray flux through ionization chamber in a beam line of synchrotron radiation source which is mounted in INDUS-2. It is one of new technique of detection. Beam line area is highly restricted because of hazardous radiation, so through this application remote interfacing is provided for the ultra low current signal detection card that can be controlled by Master software.**

The development of such type arrangement we used software in C#.NET there are many issues like develop code, Design forms, to achieve the specified response from the CPU card, code developed in C# .NET. Initially, I explored and gained the knowledge of C#.NET. I practices some small modular projects as part to learn how the system works. I used programming language C#.NET architecture version 3.5 in Visual Studio 2008.

***Keywords* – Chamber Software, Data Acquisition, Ionization Chamber, IC-DAQ.**

I. INTRODUCTION

Objective of this paper is development of master control software for data acquisition of ionization chamber for INDUS-2, RRCAT. This ionization chamber DAQ system is required for measurement of x-ray flux in INDUS-2 Beam lines at RRCAT, Indore. Software will perform on line acquisition as well as will be used for long term stability measurements. A synchrotron radiation source of nominal electron energy of 2.5 GeV and a critical wavelength of about 4 angstroms. A synchrotron is a particular type of cyclic particle accelerator in which the magnetic field and the electric field are carefully synchronized with the travelling particle beam.

Beam of particles such as X-ray beam is passed through ionization chamber; which is used for the detection or measurement of ionizing radiation. When the gas between the electrodes is ionized by x-ray beam the ions and dissociated electrons move to the electrodes of the opposite polarity, thus creating an ionization current which may be measured by an electrometer. 1 – 1.5 kV is applied between the electrodes. The applied voltage allows the device to work continuously by mapping up electrons and preventing the device from becoming saturated.

This originated current range of 1nA is to be amplified up to 10 volt using Programmable Gain amplifier. This analog signal is required to be converted to the digital signal using microcontroller 80C552. It also involves the necessary software development in assembly language of 80c552 to work as slave master control software by communication in serial port.

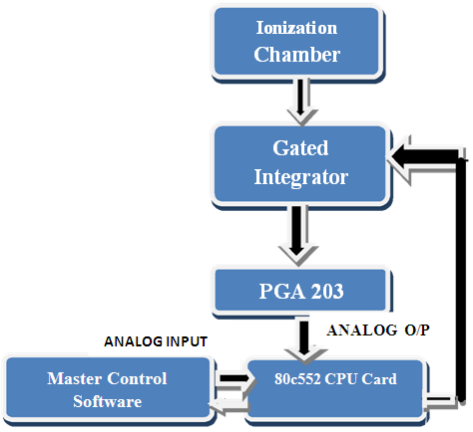

Fig.1. Block diagram of master control software for IC-DAQ of ionization chamber

Master control software for DAQ of ionization chamber for INDUS-2, will measure long term stability of the incoming X-ray beam. Master control software for DAQ of ionization chamber for INDUS-2 has built in Visual Studio 2008 on C#.NET platform. The software is to be used as master control to the instrument ionization chamber DAQ. This will communicate on RS-232 Com port, setting of the port is to be done from serial port configuration. After selection of the ports, The Master Software has to send a string on selected com port. This string will be sent when ever Link IC-DAQ Command is pressed. For the setting parameters of IC-DAQ like Integration Time, Programmable Gain and HV are to be selected from the given values. On giving set IC-DAQ parameters 3 strings are to be sent on serial port. Analog value string will be sent every Ionization chamber is mounted in beams lines. Output current of ionization chamber is input signal of gated integrator which is integrates an analytical signal over a fixed time window. PGA 203 (Programmable Gain Amplifier) provides gains of 1, 2, 4, and 8.Both has TTL or CMOS-compatible inputs for easy microprocessor interface. After that this analog signal is converted into digital signal, master control software instruct to 80c552 CPU card to set integration time, gain, and high voltage. Input signal reading will measure by master control software.

A. Software Required:

Development of master control software for DAQ of ionization chamber for indus2 is required for master of X-Ray flux in Indus 2 beam lines. This software will perform on line acquisition as well as used for long term stability measurements.

B. Hardware Description:

Data acquisition is the process of sampling signals that measure real world physical conditions and converting the resulting samples into digital numeric values that can be

manipulated by a computer. Data acquisition systems (abbreviated with the acronym DAS or DAQ) typically convert analog waveforms into digital values for processing. The components of data acquisition systems include:

(a) Signal conditioning circuitry to convert sensor signals into a form that can be converted to digital values.

(b) Analog-to-digital converters, which convert conditioned sensor signals to digital values. Data acquisition applications are controlled by software programs developed using various general purpose programming languages such as BASIC, C, Fortran, Java, Lisp, Pascal. Specialized software tools used for building large-scale data acquisition systems include EPICS. Graphical programming environments include ladder logic, Visual C#, Visual Basic, and Lab VIEW. Master control software will use serial port of PC to communicate the data acquisition system. A master slave topology based command structure will be developed to give the set point and collect data from Microcontroller 80c552.

II. . NET FRAMEWORK ARCHITECTURE

The .NET Framework is a software framework developed by Microsoft that runs primarily on Microsoft Windows. It includes a large library and provides language interoperability (each language can use code written in other languages) across several programming languages. Programs written for the .NET Framework execute in a software environment (as contrasted to hardware environment), known as the Common Language Runtime (CLR), an application virtual machine that provides services such as security, memory management, and exception handling. The class library and the CLR together constitute the .NET Framework.

A. Visual Studio 2008

Microsoft Visual Studio is an integrated development environment (IDE) from Microsoft. It is used to develop console and graphical user interface applications along with Windows Forms applications, websites, applications, and web services in both native code together with managed code for all platforms supported by Microsoft Windows, Windows Mobile, Windows C#, .NET Framework, .NET Compact Framework and Microsoft Silver light.

Visual Studio includes a code editor supporting IntelliSense as well as code refactoring. The integrated debugger works both as a source-level debugger and a machine-level debugger. Other built-in tools include a forms designer for building GUI applications, designer, class designer, and database schema designer.

Visual Studio supports different programming languages by means of language services, which allow the code editor and debugger to support nearly any programming language, provided a language-specific service exists. Built-in languages include/C++ (via Visual C++), VB .NET (via Visual Basic .NET), C#(via Visual C#), and F# (as of Visual Studio 2010). Individual language-specific versions of Visual Studio also exist which provide more limited language services to the user: Microsoft Visual Basic, Visual J#, Visual C#, and Visual. one second into the serial port. It will receive 12-bit digital data corresponding to the analog signal received from ionization chamber.

B. Study of Gated Integrator

A gated integrator (also called a boxcar integrator or average) integrates an analytical signal over a fixed time window. In pulsed experiments the integrator gate is synchronized with the analytical signal by a trigger. This method increases the signal-to-noise ratio by recording the voltage only when the signal is present and ignoring time periods when there is no signal and only noise. The following plot shows a time dependent signal. The shaded area covers 90% of the area under the curve. Integrating the signal only during this time period gets most of the signal and avoids noise at the beginning of the experiment and after the signal has decayed to zero. (Note that this simulation does not show the noise that would be typical of a real transient signal.)

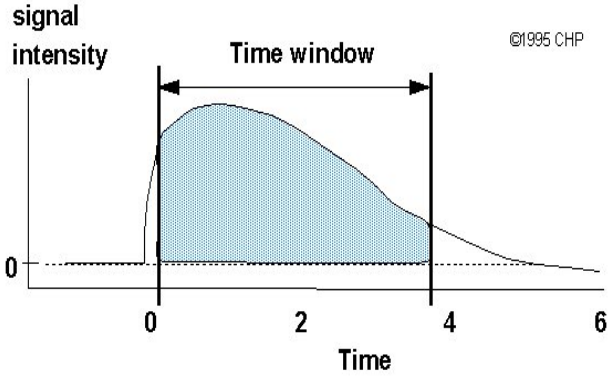

Fig.2. Gated Integrator

III. RESULTS

In the fig.3.1 show current reading which is 942 nA current. Parameters is set for IC-DAQ is following,
Integration time – 10
Programmable Gain – 01
High Voltage – 20

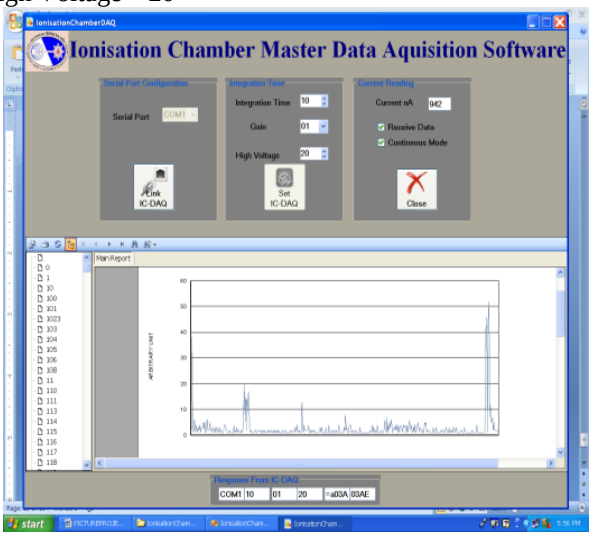

Fig.3.1 Current reading is 942 nA

In the fig.3.2 show current reading which is 951 nA current. Parameters is set for IC-DAQ is following,
Integration time – 10
Programmable Gain – 02
High Voltage – 60

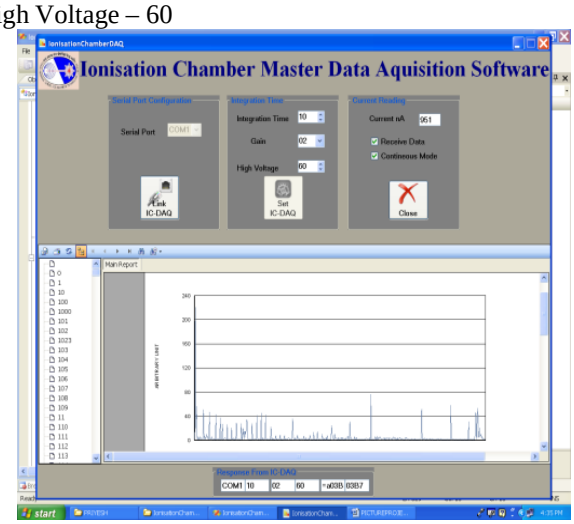

Fig.3.2 Current reading is 951 nA

IV. Conclusion

For beam lines of Indus-2 master control software to read and record the analog signal coming from the electrometer amplifier unit in digitized form is develop and tested with the compatible hardware. The software also features to set the configuration for parameters like Integration time, Programmable gain and HV from a user friendly graphic interface. It also save data in a user selectable file format like text, word, excel and PDF etc. the develop software is working satisfactory at RRCAT, Indore.

Future Scope:

Indus beam-lines are currently working in three shifts with 24*7 operating mode. Data Acquisition and experimentation demands the online data for larger time period presently these 2o minutes. It can be extended up to few hours. Present software text data from RS-232 link only using comport of the pc. This facility can be extended USB and ETHERNET. If compatible hardware will also be made available facility of further analysis for averaging software based filtering and normalization of signal with background wise may also be added.

Acknowledgement

We are very thankful to our Institute, IIST, Indore they provide us the opportunity to doing such type of research. We are also very thankful to RRCAT for guiding as for this research work.

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