

DATA ACQUISITION FROM SPECTROMETRY AND DOSIMETRY SYSTEMS USING LabVIEW ENVIRONMENT*

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Partial collisions in the superconducting collider NICA will generate ionizing radiation. Monitoring its intensity is an important task. Different third party vendor hardware is frequently used over the course of the scientific experiments including dosimeters, spectrometers, counters, and control system. Usually, this hardware has its own software and unique drivers with no API or external interfaces. CERN and JINR industrial standard is LabVIEW development environment from National Instruments. Moreover, this custom source code could be integrated with SCADA systems easily in the future. This is the reason for the decision to develop software based on USB express DLL library from Silicon Labs using LabVIEW for RADATEH RT-3.0 SiPM. The work includes modifying programs in LabVIEW for different devices (RADATEH RT-3.0 SiPM spectrometer, Geiger-Müller counter STS-5 and Gamma-Scout dosimeters) to allow a potential user to acquire data from them.

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1. Introduction

1.1. Purpose

At the Joint Institute for Nuclear Research (JINR), a new accelerator complex is being built. A superconducting collider NICA will be a centre part of this complex. The main aim of this international science project is to study the properties of nuclear matter in the region of the maximum baryonic density [1]. Due to the ionizing radiation generated during partial collisions, measuring the dose of radiation and observing the spectrum of intensity of gamma radiation is a very important issue.

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The major task was to create new or modify existing programs that had been created in LabVIEW for the following devices: RADATEH RT-3.0 SiPM spectrometer, Geiger–Müller counter STS-5 and Gamma-Scout dosimeters. An additional aim was to check if it is possible to acquire data from GS dosimeters using the Ethernet connection.

1.2. Devices

The spectrometer is an instrument used to measure the spectrum of intensity of gamma radiation.

The detector is composed of a scintillation crystal that converts energy lost by ionizing radiation into light and of the attached photomultiplier tube that changes photons striking a photocathode into electrical signal [2]. Electrons are accelerated by a high-voltage field. Obtained voltage is amplified and converted into a digital signal.

The Geiger–Müller counter is a device designed to detect all the ionizing radiation in its surroundings.

Its most important element is a GM Tube that consists of two electrodes in a cylindrical chamber filled with low-pressure gas. It is connected to a high-voltage supply: 500 volts for the LND712 Geiger tube and 380–480 volts for the STS — 5 Geiger Tube. When a particle enters the tube, it ionizes molecules of the gas. Appeared ions and electrons direct to the electrodes due to the applied electric field. Electrons created near the anode are detected as a pulse of voltage in the output of the tube. The amplitude of the pulse does not depend on the type of particle, so the device can be used only to measure general radiation [3].

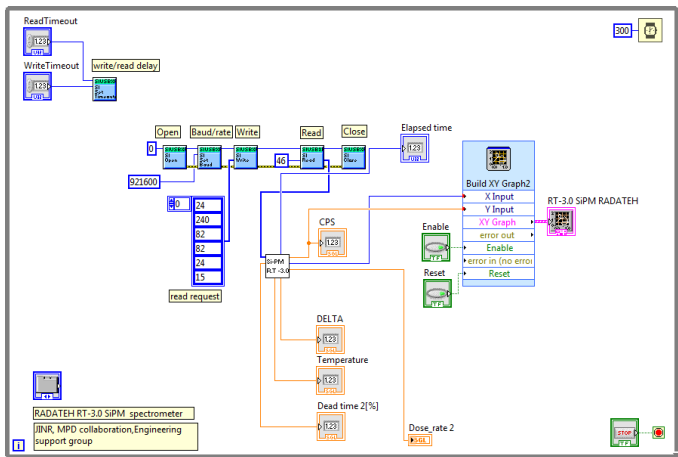


Fig. 1. Block diagram of software designed for the RADATEH RT-3.0 SiPM spectrometer.

2. Software and low-level communication

In order to read the data coming from the device, a LabVIEW program was created. The software was created using functions from a DLL library.

At the beginning of the program execution, it detects how many devices are connected to the host. After that, the function SI Get Product String returns a serial number or product description that are of type string. SI Get DLL Version obtains the version of DLL library that is currently used. Following function initializes the devices and returns handles which are used for subsequent access. Function SI Get Part Number returns the serial number for a given handle. SI Set Baud Rate sets the baud rate to 921 600 because it is the baud rate of Silicon Labs chips inside the RADATEH detector. SI Write writes a specified number of bytes from the buffer to the device. SI Read reads the available number of bytes into the supplied buffer. The front panel is shown in Fig. 2.

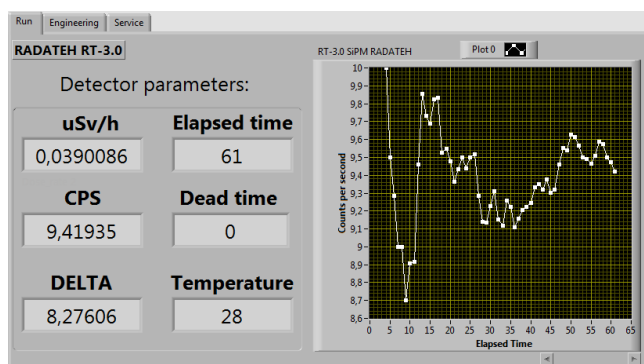


Fig. 2. Front panel of software designed for SiPM spectrometer.

There are four types of possible requests that can be indicated by the user in the control panel to obtain different responses. The first type gives information about FPGA inside the RADATEH RT-3.0 spectrometer, the second one — about the connected device, the third one gives full information (meaning status, temperature, dead time, counts, speed, dose rate), the last one provides the structure info. Response data are converted to type uint8 and then to ASCII characters. Then the loop with 30 iterations enables one to get the substrings of length one. Results are put in an array.

The second task was to upgrade existing software to count the number of impulses per minute (CPM) and to convert CPM to $\mu\text{Sv/h}$ and REM/h. Additionally, the software was modified to illustrate acquired data on a graph.

The time between the last two impulses was calculated using a one iteration of the “for” loop, which starts counting elapsed time after an impulse is detected. To obtain CPM, the number of detected impulses was divided by the time of measure. For better accuracy, the equation was closed in a “for” loop to start after one minute of measurement. CPM was then mathematically converted to $\mu\text{Sv/h}$, and REM/h and connected to a graph building tool.

Another task was to modify the existing software to illustrate acquired data on a histogram. This modification was made by exporting the dose rate data to an external text file to read it as an array of strings. The obtained array had to be converted to an array of double and then it could be connected to a histogram creating tool.

3. Conclusions

- The software to acquire data from the RADATEH RT-3.0 SiPM spectrometer was successfully created. After entering a request in the control panel, the user will get a response in ASCII characters.
- The software for GM counter was successfully modified to convert acquired data to CPM and dose rate units and to illustrate it on a graph.
- The software for GS dosimeters was successfully modified to illustrate acquired data on a histogram.
- Modifications made in programs can be utilised in data acquisition from spectrometry and dosimetry systems for the NICA program.

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