

# LABVIEW-BASED SOFTWARE FOR ELECTRON GUN CONTROLLER\*

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## Abstract

Instrument control can improve measurement level of automation. In the actual control of the accelerator electron gun, we need to obtain a voltage with different amplitudes for the filament. Boost and voltage regulator modules should be used in the 220V AC input conditions. In order to adjust the filament voltage and stabilize the filament current more convenient, we developed a control software based on LabVIEW.

## INTRODUCTION

Instrument control is often encountered in the course of the experiment. Although the current general measurement instrument can provide a high degree of automated measurement to a certain extent, but still cannot meet the actual measurement requirements. Virtual instrument (VI) is a combination of computer systems and instrumentation systems. The use of computer systems, powerful features and outstanding cost, combined with the corresponding hardware, greatly breaking the traditional instruments in the data processing, display, transmission and storage and other aspects of the restrictions, the instrument intelligent, integrated, remote and integrated monitoring and control typical example<sup>[1]</sup>.

LabVIEW is a graphical development platform for visualization of virtual instruments introduced by National Instruments, which includes the functions required for almost all test projects, from the lowest level of instrument communication VISA commands to advanced signal processing and various data reports toolkit. In this paper, through the LabVIEW development platform, we designed a set of control software for filament power supply. Friendly and easy to operate and control. Fig.1 shows the framework of instrument control<sup>[2]</sup>.

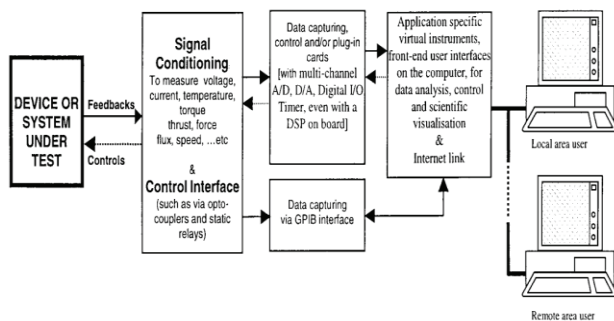


Figure 1: Instrument Control Architecture LabVIEW.

## INTRODUCTION TO ELECTRON GUN

Figure 2 is the diagram of electron gun working principle. The controller generates a hot current by applying a certain amount of current to the electron gun cathode filament to heat the filament. Since the cathode has a positive voltage relative to the gate, so there is no electron beam flow through the gate into the accelerator tube. When the controller applies a negative voltage pulse to the cathode filament relative to the gate, this negative pulse will draw a pulsed electron beam current. The negative voltage pulse width and the bias voltage amplitude can change the intensity of the electron beam by adjusting the filament current or voltage. Taking into account the role of the controller in the entire electron gun, we have to develop a set of control software for easier operating<sup>[3]</sup>.

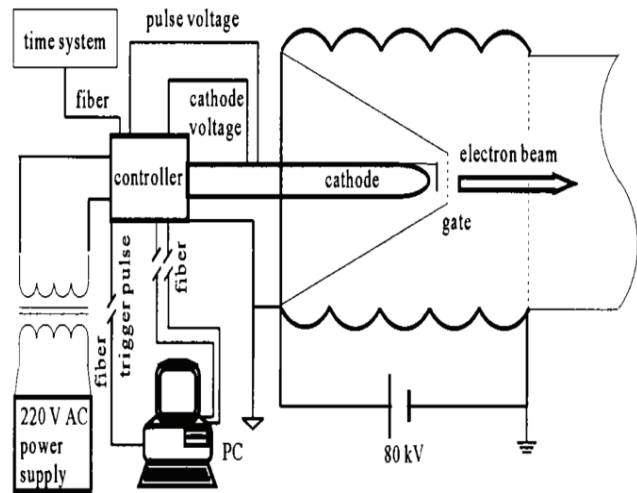


Figure 2: Structure of the electron gun.

## INSTRUMENT CONTROL

There are two ways in which a computer communicates with an instrument: one is a register-based communication and the other is a message-based communication. GPIB, serial port and USB use the message-based communication format, the commands sent by these instruments and read back the data are high-level ASCII string, the instrument itself has a processor responsible for resolving string commands and sending string data. An instrument driver is a set of software routines that correspond to a planned operation, such as configuring the instrument, reading from the instrument, writing to the instrument, and triggering the instrument. It will be the underlying communication command or register configuration, etc., the user only need to call the

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packaged library can easily achieve any function corresponding to the instrument. To sum up, are using the VISA, using the LabVIEW VISA driver to programming is still very convenient<sup>[4]</sup>.

See Fig.3, the core W&R module is based on the serial communication protocol to write.

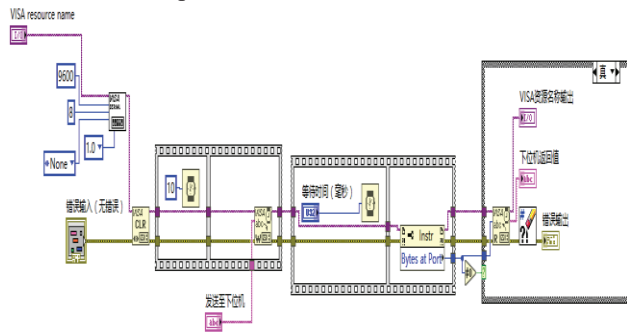


Figure 3: Serial transceiver module.

### KEY TECHNOLOGY IN CONTROL SOFTWARE DESIGN

Traditional LabVIEW has three basic loop structures: the sequential structure, the while-loop and the for-loop. We should use the way of circular queries, while-loop or for-loop must contain the sequential structure. For the complex control of the function, the program will check for each loop module, the response of the instrument to the control is too slow. This control mode is not practical.

Event Structure is a state machine program structure, it can improve the control speed of the program. A program will be automatically triggered when the event occurs. Event-driven is a passive wait process which is similar to the way hardware interrupted, thus saving the CPU resources. Events using the queue mode, also to avoid the mistakes. Event Structure is usually included in the while-loop, able to perform sleep and action accurately.

There are many Boolean variables in the control software we have designed, the program is always dormant if the button is not changed.

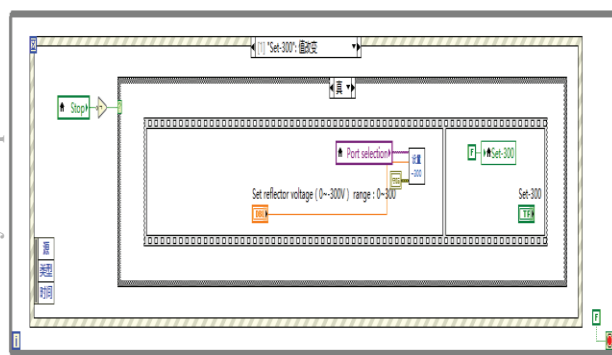


Figure 4: Framework of Event Structure.

We can use VI Server technology to control the operation and attributes of VI in LabVIEW. Attribute node is one of the most important nodes. The attribute node can change the color and size of the front panel

object in real time. Fig.5 shows the design of attribute node.

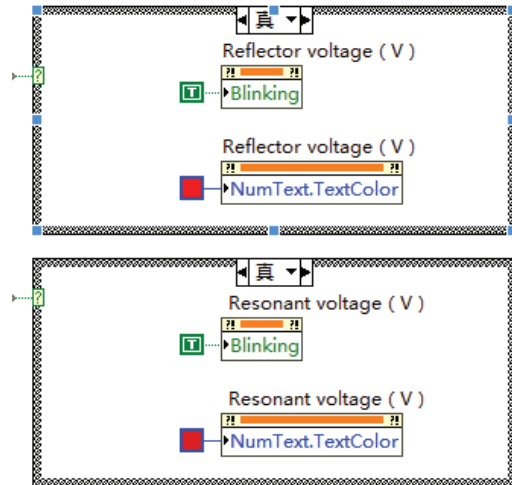


Figure 5: Design of the attribute node.

### APPLICATION

In our design, U1 requires 0 ~ 300V adjustable input, U2 requires 0 ~ 500V adjustable input. U3 requires 0 ~ 75V sawtooth wave. U1 and U2 need to be continuously adjustable. The power supply module is showing in Fig.6. When developing a measurement system, selecting the correct bus is as important as selecting a device with the appropriate sampling rate and resolution. The controller communicates with the PC via the serial port RS232.

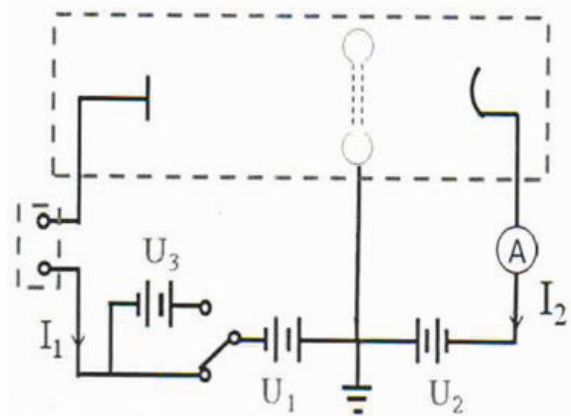


Figure 6: DC power supply module.

The software should be able to detect the connection status, sawtooth switch, external modulation status and so on. In practical applications, we may suffered power outages or other circumstances. So our controller needs to check the connection status at any time. So we make a judgment statement at the beginning of the data flow and designed for each power supply value detection. Fig.7 shows the design.

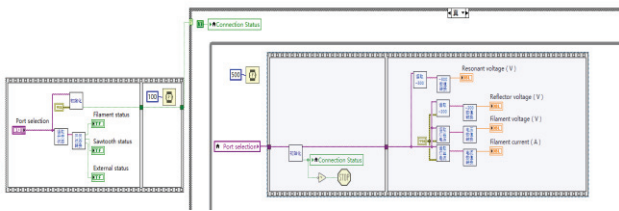


Figure 7: Design for numerical detection.

### TEST RESULTS

Test results will be affected by many factors. In order to verify the ability of the circuit system to adapt in different environments, we test the reliability of the software. Through which we set the voltage range within the transmission range and measured with a multimeter, we found that the software is running properly and the interface is simple and clear. Fig.8 shows the panel and Fig.9 shows the diagram of program.

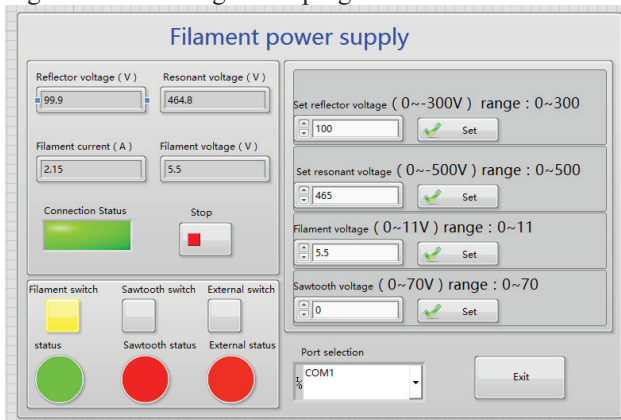


Figure 8: Front panel.

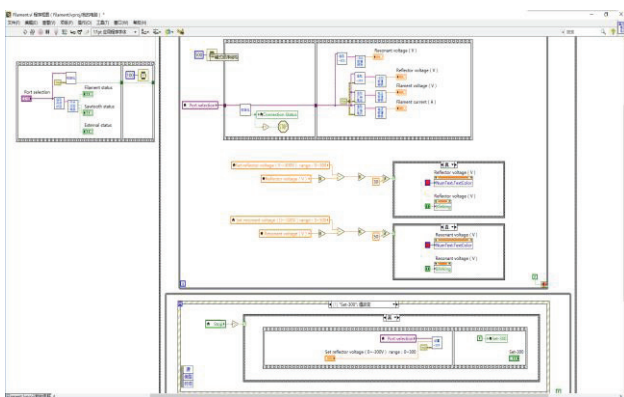


Figure 9: Diagram of program.

### CONCLUSION

Instrument control based on virtual instrument technology has the characteristics of flexible operation and good stability. LabVIEW has improved the degree of automation greatly<sup>[5]</sup>. In this paper, we designed a set of control software for the electron gun controller, shorten the system development cycle. In the future we can also use this design for other equipment according to different requirements.

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