

Automated System for DMM Calibration

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Abstract:- This paper describes the creation of a calibrator-digital multimeter system for calibration based on LabView. Special attention is paid on the problem of developing a driver to control the calibrator. As the DMM driver is available on the internet the Calibrator's one had to be created using LabView's Plug and Play Instrument Driver Development Structures.

Key-Words:- calibration, DMM, driver, instrument, LabView, structures

1 Introduction

This system consists of Wavetek's 4800 Multifunction DMM Calibrator, Keithley 2000 DMM and GPIB connection. 4800 Calibrator contains an IEEE-488 interface as standard enabling the calibrator to form the heart of a compact and highly accurate calibration and test system, while its rugged construction and insensitivity for temperatures variations make it ideal for applications outside the traditional calibration environment. It is compatible with Datron Portocol Multimeter Calibration software package, a combination which forms an automated calibration system capable of calibrating any DMM [1]. Keithley 2000 DMM is one of the most frequently used devices and performs a variety of measuring options [2]. The GPIB was developed by Hewlett Packard in the late 1960s and it is widely use for computer-to-computer and control communication because of its versatility.

2 Problem Formulations

For creating automated system an appropriate software environment is needed. For our project we chose National Instruments' LabView to develop. LabView is very helpful offering Plug and Play Instrument Driver solutions. A LabVIEW Plug and Play instrument driver is a set of VIs that controls a programmable instrument. Each VI corresponds to an instrument operation, such as configuring, triggering, and reading measurements from the instrument. Instrument drivers help users get started using their instrument from their computer and saves them development time and cost because users do not need to learn the programming protocol for each instrument. Using a standard architecture for all LabView Instrument Drivers has the following benefits [3]:

- Improves the consistency of instrument drivers for the benefit of end users;
- Improves the quality of the drivers;
- Minimizes duplicated effort;
- Improves ease of use for end users by

providing a consistent methodology for using instrument drivers from a variety of sources;
 - Streamline the instrument driver development process for the benefit of instrument driver developers.

The GPIB used in the communication is a digital, 24-conductor parallel bus. It consists of 8 data lines, five management lines (ATN, EOI, IFC, REN, and SRQ), three handshake lines, and eight ground lines. The devices including the computer were linked in a star topology [4].

Once the connection between the devices was established driver software had to be created to control the instruments. National instruments offers a ready to use solution for Keithley 2000 driver [5] but for Wavetek’s Calibrator a new one had to be created using LabView. The structure of the driver is shown on Fig. 1.

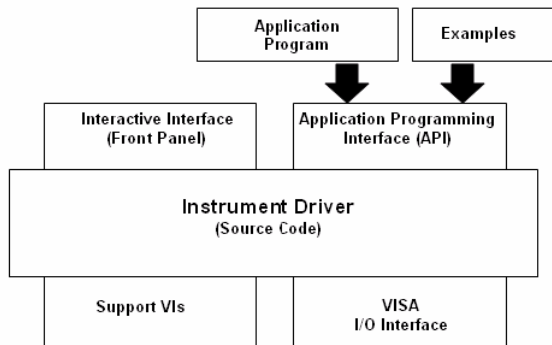


Fig. 1 LabView Instrument Driver Structure

The structure illustrates how the instrument driver presents both an interactive interface and a programming interface. The application programming interface (API) is the set of user-callable instrument driver VIs used in end-user

systems. The end user learns about the API through the instrument driver front panels. By interactively running the front panels of the instrument driver VIs, end users understand how each control affects the instrument. After they understand the settings, end users can incorporate the instrument driver VIs in their application.

The Virtual Instrument Software Architecture (VISA) I/O interface is the set of LabView functions the driver uses to communicate with the instrument hardware. VISA is an established standard instrumentation interface that controls GPIB, USB, serial and other instrument buses. Support VIs are VIs that you do not intend the end user to access directly. Therefore, support VIs is not part of the instrument driver API.

The internal structure of the instrument driver defines the organization of the instrument driver VIs. All user-accessible API VIs are organized into a modular hierarchy based on instrument functionality.

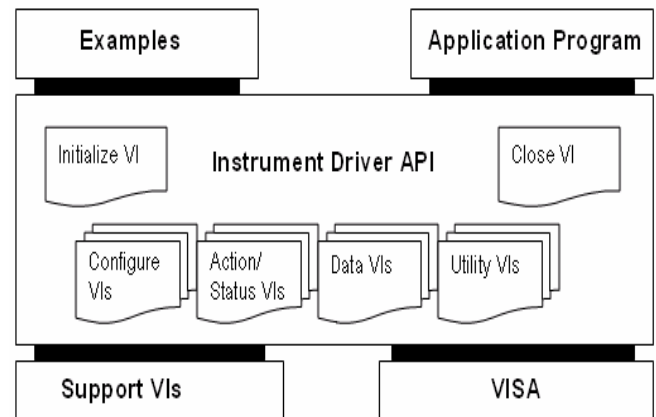


Fig. 2 Instrument Driver Internal Structure

Figure 2 shows the internal structure of LabVIEW instrument drivers. End users have the necessary granularity for controlling instruments properly in applications. For example, end users can initialize all instruments once at the start, configure multiple instruments, and then trigger several instruments simultaneously. Also, they can initialize and configure an instrument once, and then trigger and read from the instrument several times.

3 Problem Solutions

A Virtual instrument was created to control the calibration process. It contains a front panel where different options for calibration can be chosen – DC Voltage Measurement Calibration, AC Voltage Measurement Calibration, DC Current Measurement Calibration, AC Current Measurement Calibration and Resistance Measurement Calibration. User has to choose the instruments' addresses and to make serial configurations. On the front panel the values measured by the DMM are displayed also (Fig. 3).

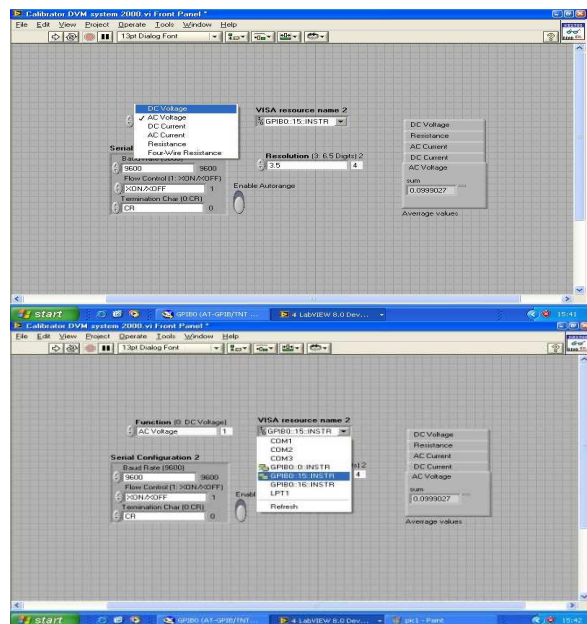


Fig. 3 Front Panel

The second part is the block diagram. The drivers of the DMM and the Calibrator are set there. The calibrating values are also on the block diagram as they are constants and will not be changed for the system. At the end of the calibration process a report is created containing information about the process – ranges, values, errors (Fig 4)

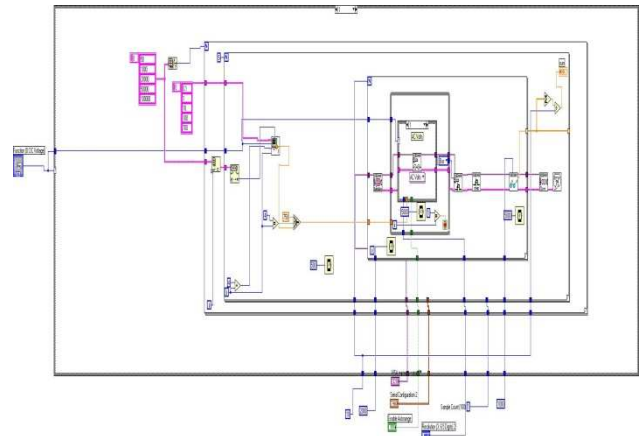


Fig. 4 Block Diagram

The synchronization between the two instruments is by time.

4 Conclusions and Future Directions

The created system is facilitating the calibration process. It improves the quality of the process by increasing the accuracy but making the process faster though. The driver configuration should be optimized as the time synchronization is not the best solution for that systems. The Calibrator driver should be developed to fulfill exactly the requirements for a successful instrument driver.

References:

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