Virtual Data Acquisition and Control through Web server and ARM Using LabVIEW

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Abstract: LabVIEW is a programming environment in which we can create programs using a graphical note, by the way, it alters from habitual programming languages similar to Java, C, or C++, whereinwe program through text. Laboratory experiments play a vital role in engineering and science education. Computerization has changed the structure of these laboratories, there is an ease of use of various interfacing tools to access laboratory setup remotely through the computer connected surroundings. These accessing can be made possible through internet. This paper provides data acquisition and control through Web server with high secure substantiation system. Data acquisition has been made through a designed hardware support of ARM7 and necessary interfacing. System generated arbitrary password will be sent through a GSM modem connected with server. LabVIEW supported tools are used to create Web server and Database Connectivity Tool Kit will be used to have database management of user access. Data measurement be made through the VISA driver, its purpose is to try to mingle instrumentation software values, whether the instrument uses GPIB, PXI, VXI, or Serial (RS-232/422/485).
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1. Introduction

Programmers build up software applications every day in order to augment efficiency and productivity in a mixture of situations. LabVIEW, as a programming language, is an influential tool that can be used to help achieve these goals. LabVIEW is a realistically-based programming language developed by National Instruments. Test and Measurement (T&M), Automation, Instrument Control, data acquisition [5], and data analysis applications uses its graphical nature makes it idyllic. This results in momentous productivity enhancements over conservative programming languages. National Instruments centre of attention on products for T&M, giving them a high-quality insight into developing LabVIEW. A Virtual Instrument (VI) is a LabVIEW programming element. LabVIEW, a data-flow graphical programming language, played a considerable responsibility in the prelude stages of our lab growth. The conventional or concrete laboratories are arbitrated by computers with the initiation of computing technologies. Virtual and recreation laboratories are helpful in some cases because they reduce the burden of creating real laboratory [1], [2] infrastructure and lessen learning time.

The design deliberations of online experimentation systems have a common goal of providing real-world occurrence with the control objects analogous to manualoperation and the live measurement of the experimental constraints [6], [9]. This paper describes the design of a Web server interface for electrical machines with the illustration of experiments on separately excited DC motor. This paper is structured as, Section 2 Web Server development. Section 3 portrays Hardware Accomplishment and Interfaces for Parameter Measurement [12]. Section 4 illustrates Verification Technique through GSM and Conclusion.

2. Web server Development and Publishing

The main aim of this paper is to measure current, voltage and the speed of the DC motor of laboratory experiments [2]. DC motors are commonly used to operate machinery in a variety of applications. Experiments using DC motors are very common and important in engineering studies [2], [3]. Remote access of these DC motors requires a safe design module and interfacing circuits. A Web server is a vital entity which can be connected using online services [2]-[6]. Both static and dynamic images of a front panel VI can be viewed remotely [7]. The Web server allowsus to view the front panel of an application as well as provided an ability to control the VI. We can control by giving the command remotely using a browser for the specified application.

As mentioned earlier we can control a LabVIEW application or front panel remotely using a browser [7]. The flowcharts give various operations

of the LabVIEW Web server. Figure1 shows the authentication process. After the deployment of Web server [1]-[6] on LabVIEW the module will be published on the internet. In order to publish, the internet server requires a web publishing tool. The front end design of the LabVIEW Web server contains authentication system. The user must provide a Username and Password for signing in. Those Username and Password will be verified with a database. As a result of match, the server generates a random password for a particular user and corresponding generated password will be sent to user through GSM module [9]-[11]. Received random password will be again verified and further process will be obtained.

2.1 Database Connectivity Tool Kit

The LabVIEW Database Connectivity Toolset [15], [16] is an append package for accessing databases. The toolkit contains a set of sophisticated functions for performing the most familiar database tasks and higher functions for personalized tasks. The main features of the LabVIEW Database Connectivity Toolset are as follows; Works with any contributor that holds to the ADO standard. Collect data from remote systems, maintains outsized amounts of data and elegant data manipulation. It maintains a high level of storage portability. DB Tools Open Connection VI is used to connect database by the connection string.

Figure2 shows the database palette layout information. The palette shows modules to retrieve data from corresponding database.Open connection and Close connection module create a connection with ADO based database's. The default ADO ODBC provider permits the use of SQL statements with all supported database systems, even non SQL systems create tables, selects, inserts, updates and deletes records without using SQL statements.

The measured data are obtained through serial port communication. In order to collect data via serial communication LabVIEW uses VISA Toolkit [15], [24]. Previous to collecting data, the user must state or select the input. In this paper we obtain the data's of current, voltage, speed of DC motor, load status etc., to select the corresponding input particular data will be sent through serial communication. Once the data are acquired through graphical code, those data's will be represented in different form here we use meters and the waveform chart to represent the data. At each execution of code an output will be represented through these modules. The array element is used to mention periodic values. Data are measured continuously for a time interval period of 500ms. A While loop is responsible for obtaining the data's continuously. This process will be repeated until the sign out Boolean function is received.

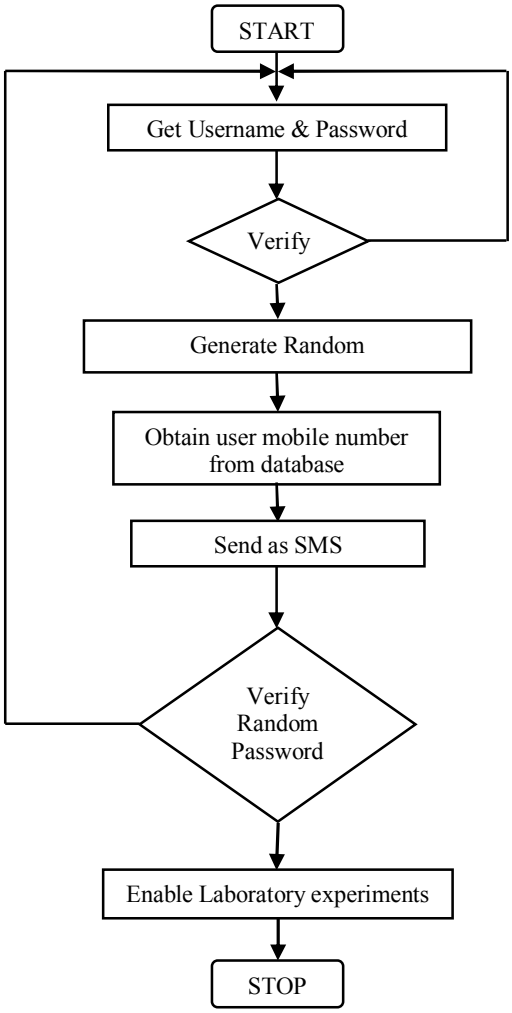

Figure 1. Flowchart Representation of Authentication through Random Number

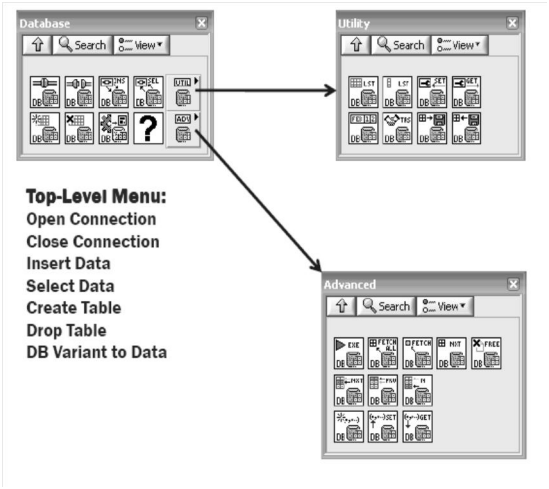

Figure 2. Database Palette layout

3. Hardware Implementation and Interfaces

The principle behind the ARM architecture is based onRISC standards.The RISC instruction sets and interpret mechanisms are easier than CISC [10]. This results in, increased instruction throughput and stimulating real-time interrupt response from a tiny and cost-efficient processor core. With pipeline techniques, all elements of the processing and memory systems can functionconstantly and fast manner. The LPC2129 incorporates a 128kB and a 256kB flash memory system respectively. Flash memory can be used for programming and carry out in several ways. It may be programmed in system by means of the serial port. Whereas the application is running, the application program may also erase and/or reprogram the flash memory, allowing an immense level of litheness for data storage field firmware promotes, etc.

With their packed in 64 pin pack, utilizes less power,different timers, 4 channels of 10 bit ADC, 2 numbers of advanced CAN channels, PWM channels and 46 GPIO lines with multiplexed interrupt pins, these microcontrollers are most widely used for industrial automotive and controlapplications as well as medical applications.

3.1 Control and Measuring Unit Module

In this work the control unit module is being used to control input voltage and load. It consists of interface circuit to drive relay unit for driving motor and load. A low voltage DC motor is used to drive or change the input voltage. Input or control signal for DC motor will be driven from ARM processor [10]. Interface module contains a switching circuit to control relay unit. The polarity of the DC supply governs the direction of rotation of the motor, which tends to elevate or reduce the input voltage. The motors are powered by the DC supply of ±12V, which make easy the control of input voltage to the DC machines.

A pair of digital outputs is required for the control of the input voltage to any one of the motor windings. Another sole characteristic provided in this test method is the facility to control the load remotely. The voltagemeasurement and current measurement [13], [14] is made through corresponding sensors. The analog values of these sensors will be converted as a digital data using inbuilt ADC of LPC2129. Here we use analog channel 0, channel 1 and channel 2 for various data measurement. Speed will be calculated using a proximity sensor. The input pulse of proximity sensor will be captured for a particular period of time. From the measured value, the DC motor speed will be calculated. These input signals are further processed using LabVIEW functions to read the real value of the experiment.

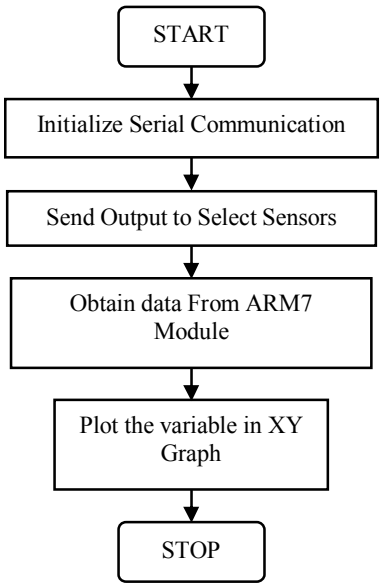

Figure 3. Flow chart representation of data acquisition (ARM7 Module)

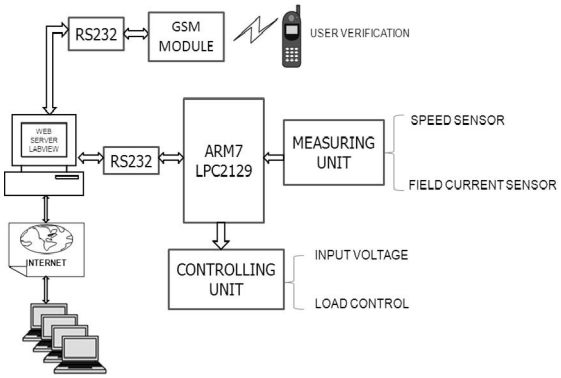

Figure 5. Hardware Implementation block diagram.

4. Hardware verification through randomnumber generation

LabVIEW provides random number generation module, it creates a binary exactness, floating point number between 0 to 1. The number engendered is larger than or equivalent to 0, but less than 1. The allocation is homogeneous. In this Work, random number generation module will be multiplied by 1000 to get three digit temporary passwords. Figure6 shows the random number generator module [15], [24].

Figure 6. Random Number Generator

GSM modem will be connected through serial communication. Since, this work needs two COMM ports for serial communication, some server may in need of serial to USB port converter.

4.1 LabVIEW VISAcontrol configuration

VISA [12], [16] is a typical Input/output Application Programming Interface for instrumentation programming. VISA can control General Purpose Interface Bus, serial bus, Universal Serial Bus, Ethernet, PCI eXtensions for Instrumentation or VME eXtensions for Instrumentation instruments, building the appropriate driver calls depending on the kind of gadget you use so we do not have to gain knowledge of instrument-specific communication etiquette [20]-[24]. It is platform sovereign, bus autonomous and an environment free. In further declarations, the same Application Programming Interface is employed despite the consequences it can be programmed on message-based instruments with sophisticated character strings. The standard commands for Programmable Instruments regiments the ASCII based command strings used to program. Similar instruments often use similar commands. To use VISA Standard I/O API for serial communication following steps will be followed,

- The Functions>>Instrument I/O>>Visa Palette>> VISA Serial Configuration
- The Functions>>Instrument I/O>>Visa Palette>> VISA Serial Read
- The Functions>>Instrument I/O>>Visa Palette>> VISA Serial Write

5. Results

Figure 7. Web page displaying with control parameter and authentication system

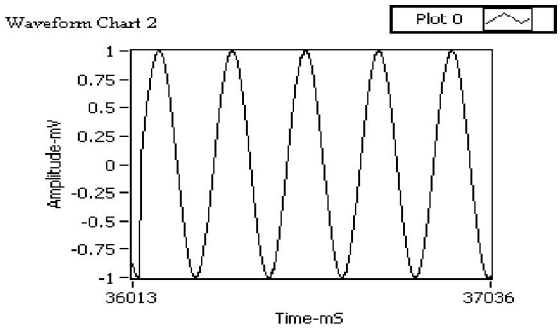

Figure 8. Sensor 1 Plot Graph

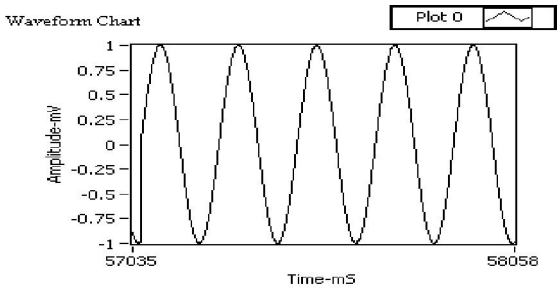

Figure 9. Sensor 2 Plot Graph

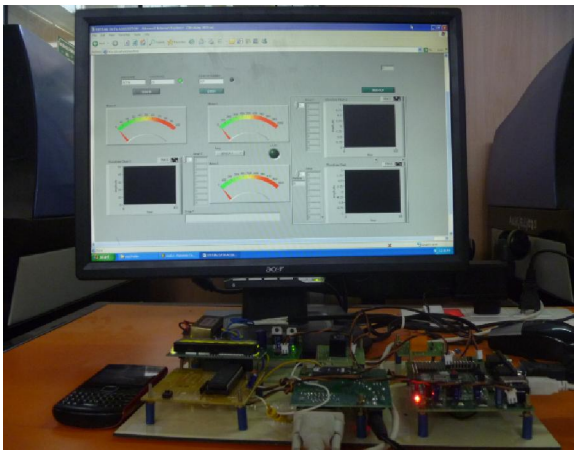

Figure 10. Hardware and overall system

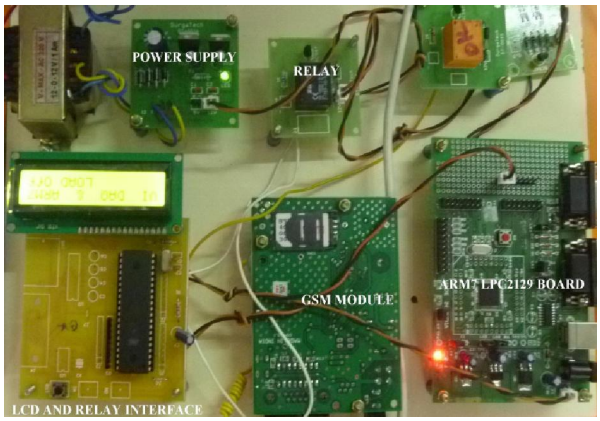

Figure 11. Complete hardware module with GSM modem and Interface circuit module

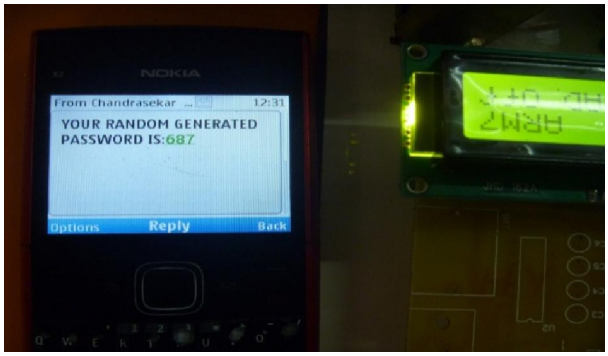

Figure 12. Random number SMS format

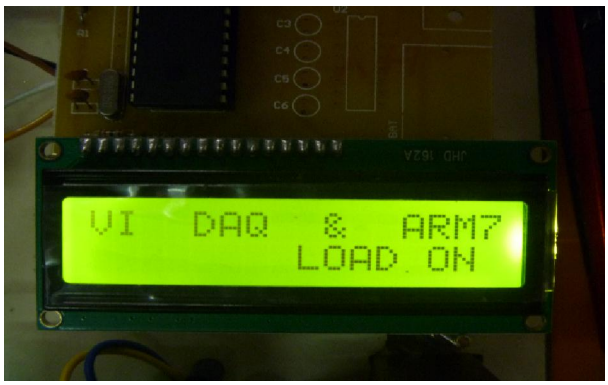

Figure 13. Display unit of current status

6. Discussions

This application creates a virtual data acquisition through low power high end processor. As a result, any laboratory can be experimented virtually through an online server. Remote laboratories across the countries can also be experimented or their data's can be shared virtually through remote servers. Since low power processor ARM7-LPC2129 is being used, power consumption will be reduced. NI provides its very own module for data acquisition, since each module cost high, instead a specific design has been implemented with low cost and high end processing. The application hardware which is proposed is in DC machine experimentation in engineering studies, even this can be modified for other laboratories such as DIGITAL CIRCUITS, ELECTRONIC CIRCUITS, DSP SIMULATION, and etc., respectively. ARM7-LPC2129 consists of 4 ADC channels of 10 bit, as a result this processor has been used to design low power hardware interface. Even those can be modified according to application with ARM9, RABBIT processors etc., as a future work. This application is designed with high secured access of Web server through a random password generator, which ensures the user secured access to laboratory in case any scientific experiment data sharing made between countries top scientist.

Figure7 shows the client side web page access on the browser. Figure 8 & 9 shows the Sensor 1 & 2 data XY plotted graph. Figure 10 & 11 shows the complete hardware module and interface circuits of the overall system. Figure12 shows the SMS format of the randomly generated password. Figure13 shows the display unit.

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