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Login Management System for Remote Labs using Labview Web Services

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Abstract:
Laboratories are essential part in science and engineering fields. It not only demonstrates ideas, but also it provides a practical hands-on experience to the students. Remote lab is a replacement of physical labs to some extent. It removes time and geographical constraints and allows students to access experiments from anywhere in the world. The project is intended to create a login management system for the remote labs set-ups so that multiple accesses to the experiments can be provided maintaining user's privacy. Two separate applications shall be developed, one to be used by server and another to be used by clients. In the Client side, two kinds of users are present, the admin and the registered users. The functionalities of the admin involve registering a new user and accessing experiments. Registered user's functionality involves selecting and accessing experiments. Each client can have labview runtime engine and executable file which is built for the clients to run the application.

1. Introduction

Laboratories are essential part in science and Engineering fields. It not only demonstrates ideas, but also it provides a practical hands-on experience to the students. With the new inventions in computer and telecommunication field the Remote Laboratories are becoming increasingly popular now-a-days. Remote Lab is a replacement of Physical Labs to some extent. Many of the universities are using e-learning courses now-a-days. If they want to provide practical hands-on experience to the students over the internet the Remote Lab concept should be used. Remote Labs removes time and geographical constraints and allow students to access experiments avoiding dangerous failure situations.

Remote Labs facility can be provided to users to access Power systems and Power Electronic devices such as Temperature Sensors, Voltage Sensors etc.

Different architectures can be used to support this environment. Some of these are based on open-source software such as PHP, JavaScript, Java, Python, AJAX, etc. whether some are based on proprietary software solutions such as Labview. Since, Labview is used in many professional environments (industry, research and development, etc.) and it is one of the new trend technologies, Labview web service has been chosen for this purpose.

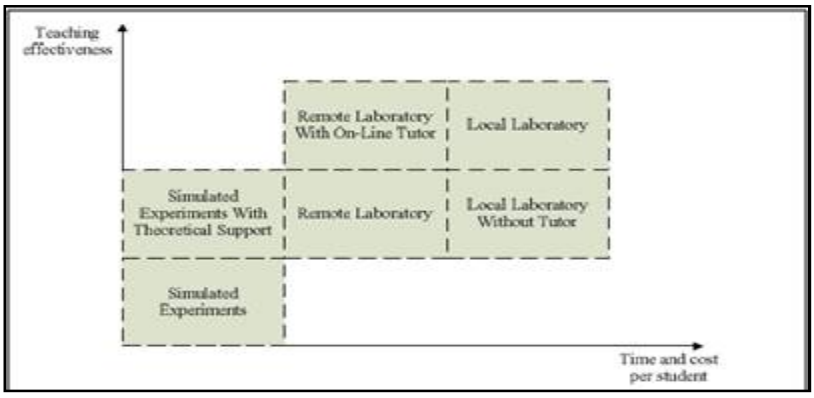

Figure 1: Comparison between remote and physical laboratories

2. Related Work

In the paper titled 'Extending Global Education through Remote Laboratory Access', the development of a remote ergonomics laboratory which is based on such an Internet technology is described. Remote lab technology is being used in engineering and science education successfully for some time, but the application of this approach is new to human factors engineering and ergonomics education. The laboratory has brought global interest and made international collaboration in teaching and research.

In the paper titled 'Distance-Learning Remote Laboratories using Labview', information about distance learning remote laboratories and how it can be more useful over physical laboratories is described. Different Factors of these two laboratories are compared. This paper also mentions some of the Current Remote Laboratory Successes like 'Cyberlab' by Stanford University, 'Lecture Enhancement' by Swiss Federal Institute of Technology, Virtual Laser Laboratory by Dalhousie University etc. The Paper also mentions the National Instruments Solution -- Labview Remote Panels for accessing remote laboratories.

In the paper titled 'Remote Panels in Labview -- Distributed Application Development', development of Distributed Application Development through Remote Panels in Labview is described. Several versions of Labview have the ability to develop different distributed applications such as TCP/IP, Internet Toolkit, VI Server, Web Publishing, Remote Data Acquisition (RDA), DataSocket, and so on. In addition, different third party toolkits have enabled internet-based VI control like LabVNC and AppletVIEW. Then, a PC and other similar applications have always been there anywhere that provide general remote control of a PC. Additionally, it describes about the steps of configuring remote panels.

3. Proposed Work

Labview Web Services can be used to facilitate remote controlling and monitoring of Power Systems and Power Electronic devices. Users can access those devices as remote Laboratory Set-ups from anytime, anywhere in the world.

To provide this facility we need a login management system so that only authorized users can access those experiments, multiple users can access at the same time, and Users can be scheduled a portion of time so that impartial access to the users can be provided.

The Login Management System Architecture for Remote Labs is given below:

3.1. System Architechture

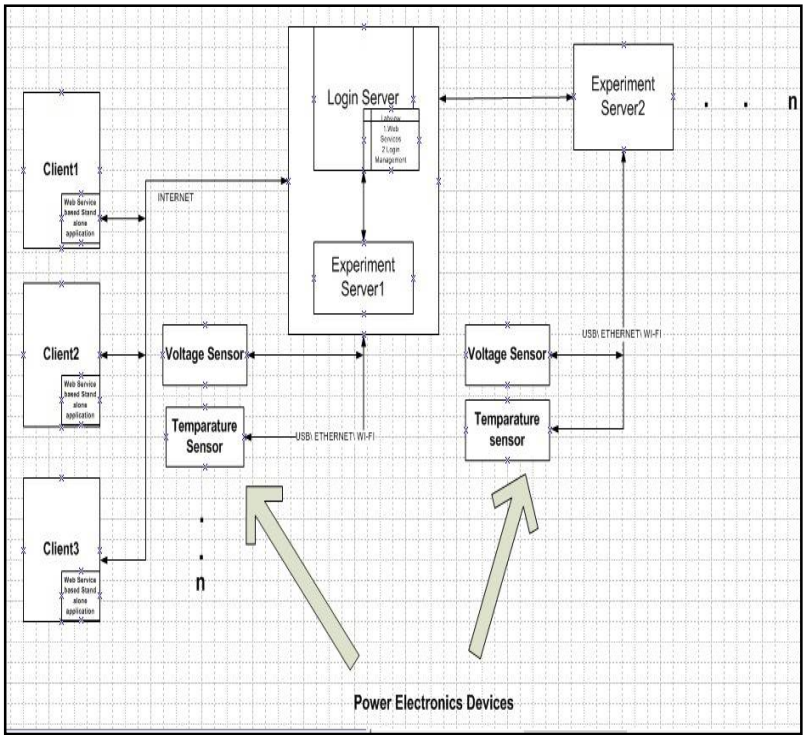

Figure 2

There will be two separate applications for clients and server. Each Client that wants to access the remote lab set-ups of power electronic devices should have the application (which is built for client) installed in their system. In Server side another application should be installed. Clients and Server can communicate through that application.

There will be one login server in which the application will be installed and multiple experimental servers to manage those experimental devices. Each device/Experimental set-up should be connected to Experimental Server. Experimental server can be as the login server as well as a separate server.

3.2. Implementation

3.2.1 Pseudo Code-Server Side

a. Temperature Sensor:

- Algorithm
  - → Step 1: Create a new web service in the existing project in the server.
  - → Step 2: Create four inputs and one output, name inputs as X, level, heater and stop and output as thermometer.
  - → Step 3: Connect the Web service request to query string and create an indicator.
  - → Step 4: Compare if X is greater than 0 and level value is less than 0 than, level value should be added to 25 and that value is given to thermometer output. If X is greater than 0 and level is greater than or equal to 0, the level value should be divided by 2.8 and the divided value should be added to 25 and given to thermometer. If x is less than 0 then then thermometer should display a value 0.
  - → Step 5: Connect all the inputs and outputs to connecter Pane.
  - → Step 6: Save the program and publish the web service.
  - → Step 7: Copy method URL and paste it in a browser.
  - → Step 8: Give values in the inputs in the URL and a get output in XML format.

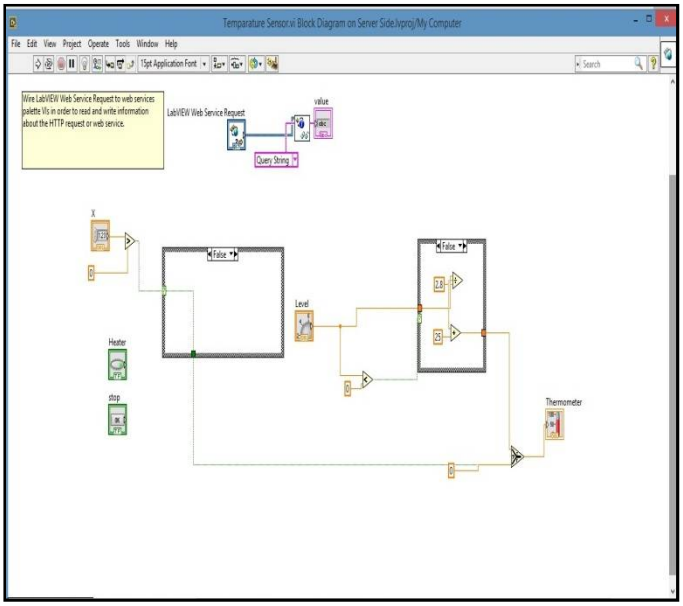

Figure 3

b. Voltage Sensor

- Algorithm
  - → Step 1: Create a new Web service in the existing project in the server.
  - → Step 2: Connect the Web service request to query string and create an indicator.
  - → Step 3: Create four inputs and three outputs, name inputs as X, PWM, light and stop and outputs as Voltmeter, ac frequency and waveform graph.
  - → Step 4: Connect the PWM value as the amplitude input to the Simulate Signal vi.
  - → Step 5: Compute the frequency and RMS value of the produced sine wave.
  - → Step 6: Multiply the sine wave value with 3.5 and give it to the Waveform graph output.
  - → Step 7: Multiply the RMS value with 3.5 and give it to Voltmeter output.
  - → Step 8: Give the frequency value to the Ac frequency.
  - → Step 9: Compare if X is greater than 0 than select the above values for the outputs else all the outputs should give a 0 value.
  - → Step 10: Connect all the inputs and outputs to connecter Pane except waveform graph.
  - → Step 11: Save the program and publish the Web service.
  - → Step 12: Copy method URL and paste it in a browser.
  - → Step 13: Give values in the inputs in the URL and a get output in XML format.

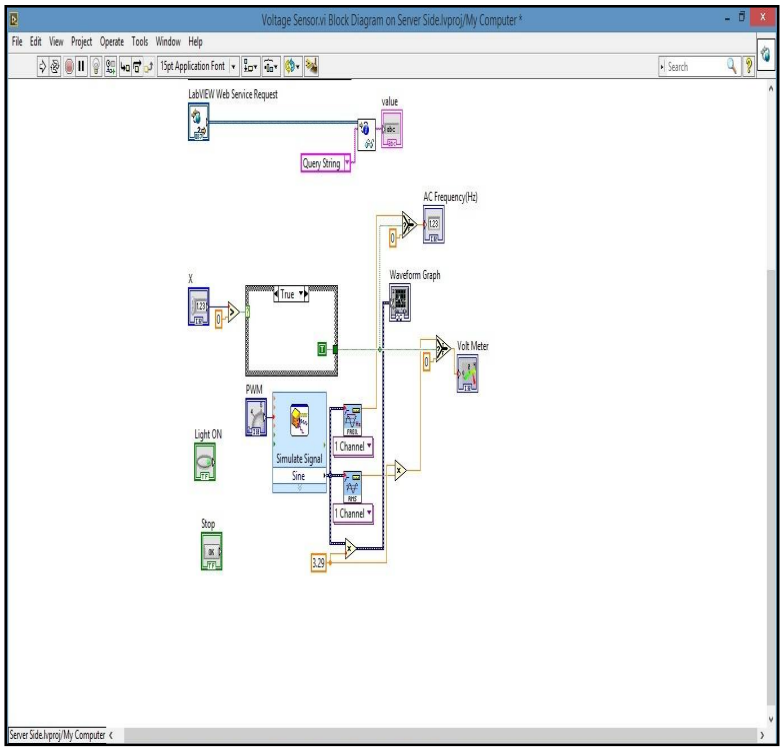

Figure 4

3.2.2. Pseudo code-Client side

a. Temperature Sensor

- Algorithm
  - → Step 1: Log in as administrator or user with authenticated username and password.
  - → Step 2: Click on the Temperature Sensor button.
  - → Step 3: Press the Heater on button in the Temperature_Client Page.
  - → Step 4: Adjust the value of Level input.
  - → Step 5: If the Heater on button is off, Thermometer Value will not change else it will be changed according to the individual inputs by the User.
  - → Step 6: Press stop button to stop the application.

b. Voltage Sensor

- Algorithm
  - → Step 1: Log in as administrator or user with authenticated username and password.
  - → Step 2: Click on the Voltage Sensor button.
  - → Step 3: Press the Light on button in the Voltage_Client Page.
  - → Step 4: Adjust the value of PWM Duty cycle input.
  - → Step 5: If the Light on button is off, Voltmeter and sine wave Value will not change else it will be changed according to the individual inputs by the User.
  - → Step 6: Press stop button to stop the application.

3.3. Snapshots

3.3.1. Labview Web Service application as a client:

a. Client Login page

The below figure represents the login page where the User logs in the application either as an admin or as a registered user by giving a valid combination of username & password.

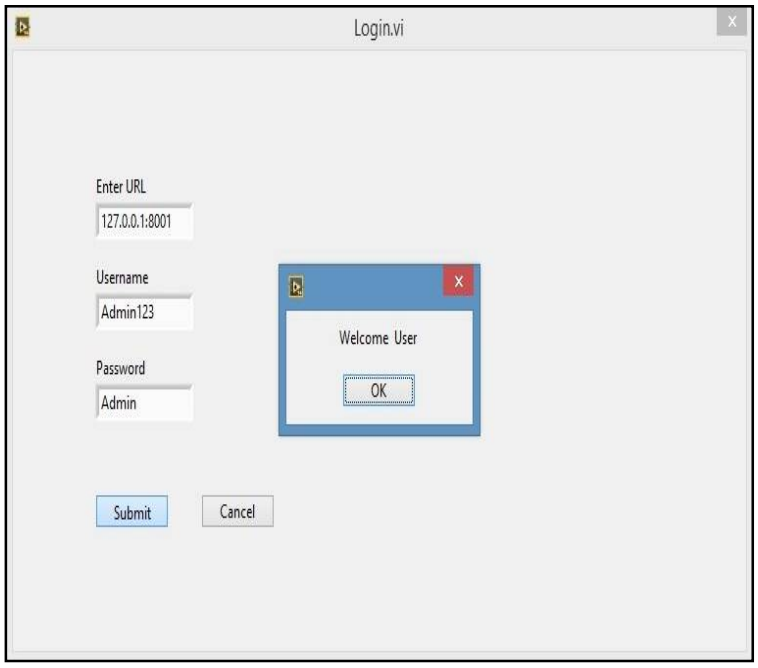

Figure 5

b. Register User

The above figure represents the Add_User vi which only admin can access and after giving values in all the fields, when add button is pressed, the user details will be saved in the database in the server and a message is popped up about successful registration.

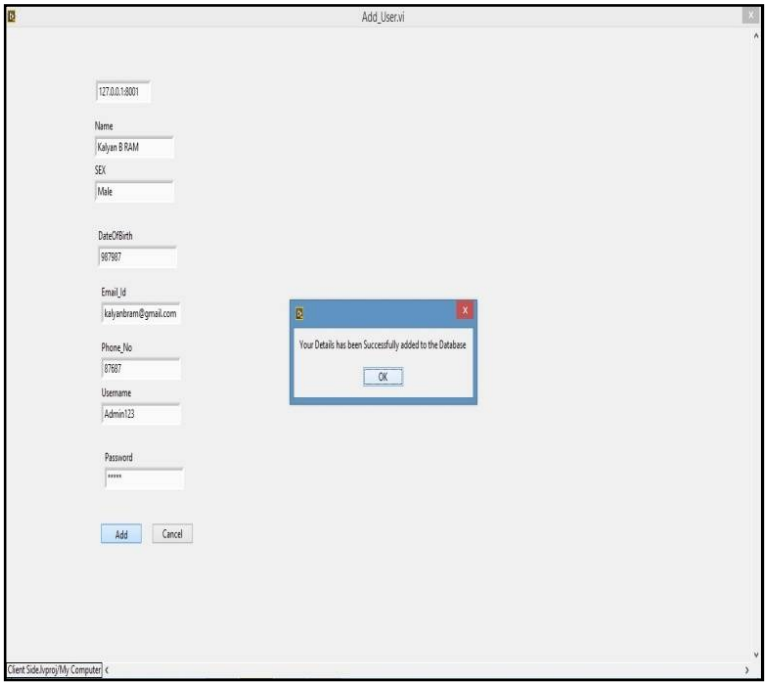

Figure 6

c. Temperature Sensor

The below figure represents the Temperature Sensor vi which only authorized users can access. Multiple users can access this vi at the same time. All users can give their own input value in the level knob and depending on their inputs; each user will get different thermometer value.

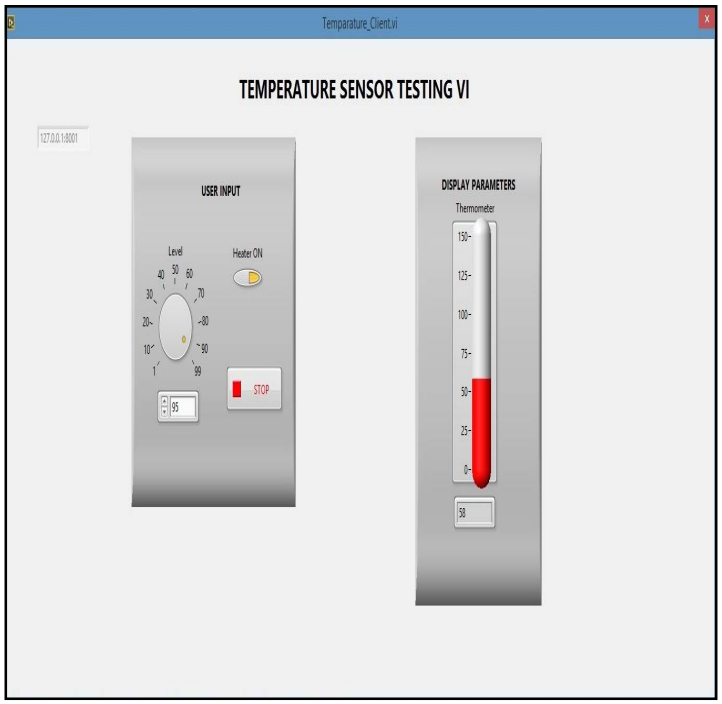

Figure 7

d. Voltage Sensor

The below figure represents the Voltage Sensor vi which only authorized users can access. Multiple users can access this vi at the same time. All users can give their own input value in the PWM Duty cycle knob and depending on their inputs, each user will get different Voltmeter value and different sine waves.

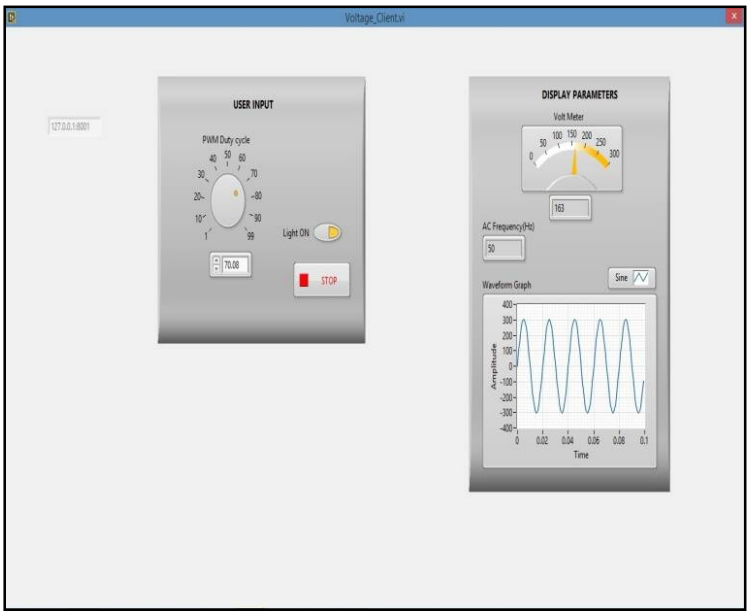

Figure 8

3.3.2. Browser as a Client

a. Voltage Sensor with browser as a client:

The below figure represents the XML output of the Voltage Sensor module. Here, browser is acting like a client. The URL of the Voltage Sensor Web service vi is copied from the server and pasted in the URL field of google chrome browser. The required values in the input fields are given. The output is in the form of XML, Which displays a voltmeter and an ac frequency value to the user.

Figure 9

b. Temperature Sensor with browser as a client :

The below figure represents the XML output of the Temperature Sensor module. Here, browser is acting like a client. The URL of the Temperature Sensor Web service vi is copied from the server and pasted in the URL field of google chrome browser. The required values in the input fields are given. The output is in the form of XML, Which displays a Thermometer value to the user

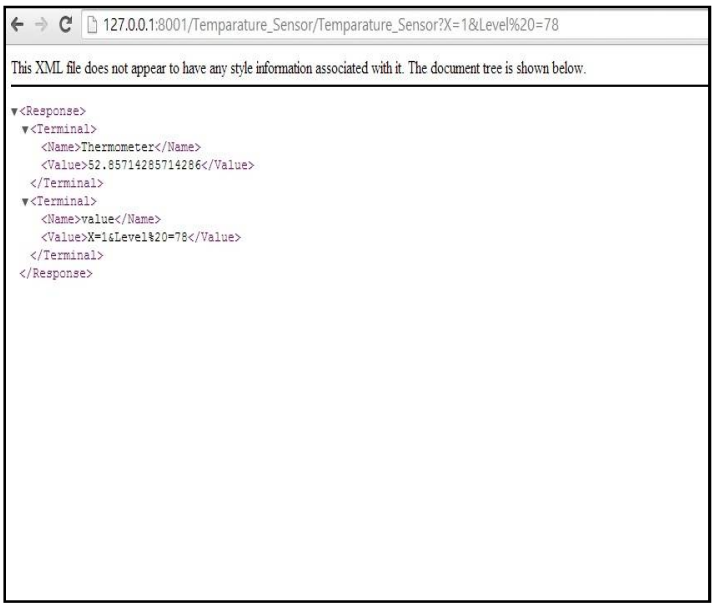

Figure 10

3.4. Results

3.4.1 Voltage Sensor

SL NO.	Light On	PWM Duty Cycle	Voltmeter	Sine Wave Amplitude
1	true	0	2	0
2	true	50	116	~200
3	true	95	221	400
4	true	99	230	>400
5	false	Any input	2,fixed	0,fixed

Table 1

3.4.2 Temperature Sensor

SL NO.	Heater On	Level	Thermometer
1	true	1	25
2	true	60	46
3	true	52	43
4	true	99	60
5	false	Any Input	25

Table 2

4. Conclusion and Future Work

Remote labs are replacements of physical Laboratories. The project is intended to provide login management system for remote labs. When Users provide their login credentials, if those data map the data in the Server they are provided access to the application else they should get an error message about unsuccessful registration. All the modules have been thoroughly tested according to the requirement specification and accordingly results have been produced. The project is implemented and tested on different clients giving different inputs at the same time and getting different outputs.

The project is currently implemented & tested using simulation of real hardware. It can be implemented on real hardware experimental set-ups to get the real data.

5. References

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