Abstract:

1. Usage of remote- controlled labs using instruments by using PLC to control and monitor the process.
2. PLC is installed with a SCADA system for the monitoring and to maneuvering by applying limitations on Motors from crossing the threshold in terms of load and speed which is applied for the motor’s protection.
3. Lab experience from far areas can lead economical reduction of expense and higher user congeniality and satisfaction.
4. Thus, Scada acts like a web interface which gives accessibility to real time equipment via internet.

Introduction:

1. **Problem Statement:** High Revenue fundings are required for the maintenance of a physical lab as it contributes to factors like area required to keep the equipment, expenditure on hiring Professional lab assistants to maintain costly equipment and as the cost of hiring and machines in itself is high, thus a smaller number of these utilities are purchased leading to high disproportionality in student to equipment ratio (i.e. multitude number of students to less amount of equipment.)
2. Practical experiences for students in these circumstances seem very vague and high demand thus a better alternative would be to use the SCADA technology for a closer hands-on experience with laboratory equipment.
3. The utilization a SCADA system for monitoring of processes and handling real time instr.
4. It is easy-to-use interface enabling operations such as supervision of measuring units and high complex calculations
5. Tangential changes in input variable on graphical user interface can be observed critically during experiment. The experiments data can be downloaded in tabular format.
6. Agenda is for helping customers, clients and students in computer networks, OS ,Process Control, Industrial Functionalities , and Electrical Machinery labs while offering an opportunity to make better functioning remote replacements of PLC and SCADA.

Overview:

The components in the setup:

1. Magnetic power brakes act like a load
2. Encoder for movement of object.
3. AC/DC Converter acts like load magnet brakes
4. Frequency Convertor for changing speeds
5. RS-485 cable/ Profibus / Modbus cables for SCADA and PLC communication linkage
6. PC (i3 or i5 process, AMD with 8 GB or higher RAM and GPU, SSD with at least 256 GB)
7. Multi-compatible display unit for the brakes
8. 1kw tri-phased motor for induction purpose.

The components that control the setup:

1. PLC + Analog I/o modules - used for the maneuvering the Setup
2. SCADA – connected to the PLC, uses its Accessing features a web system is developed   
   2a) SCADA Screen (TIA Portal): offers HMI development, runtime operation, and system diagnostics.

A) Manual Control:

1.Manual control implies users directly feeding control parameters to the system without relying on automated controllers.

2. Users manually finetune parameters such as inverter output frequency for speed variability or voltage supplied by the ac/dc converter for load level regulation.

3.As the operators have a direct access to adjust the control parameter thus the dependency on automated controllers reduces to negligible.

4.In cases of malfunctions, as the user has full access for changing parameters like load and speed according to their judgements and analysis immediately.

B) Automatic Control (PID Control):

The activation of the PID controller is facilitated by toggling the MAN/AUTO button into AUTO mode. During stable operational conditions, the PID controller functions to precisely adjust the output value, striving to minimize the error (e) to zero. This error is quantified as the disparity between the setpoint (representing the desired operational state) and the process variable (reflecting the actual operational state).

The flowchart, showcased in Fig. 1, delineates a single operational cycle of the PLC program. Operating at a scan cycle time of 5–6 ms, the program guarantees swift processing and response. Initially, the PLC establishes connectivity with the SCADA system, facilitating seamless communication and data interchange. Default settings position select buttons as CW (indicating clockwise rotation), MANUAL, and UNLOAD, offering initial configurations for system functionality. Upon program commencement, users possess the capability to manually adjust the inverter output frequency via the designated slider denoted as FREQ. This adjustment directly impacts motor speed, empowering users to finely adjust system parameters according to their preferences. Activation of the AUTO mode initiates the PID controller, facilitating automated control and optimization of system performance. Furthermore, the flowchart stipulates limitations for both load and current to avert overload scenarios, thereby ensuring the system's structural integrity and operational stability.

Scada System:

1. Electrical and mechanical systems can be managed with the use of SCADA systems.
2. Thus, SCADA not only economically minimizes costs but also educates different work and educational classes to raise aware of remote working and handling of components.
3. Therefore, a user can access substantial information by pressing the ‘i’ button on their PCs.
4. These systems have a major and significant use of Control panels for editing input variable values into real time values
5. A control panel in SCADA system consists of:
6. Controls for managing frequency for motor speed.
7. Push buttons for start and stop
8. Select buttons for changing the direction, mode and position like loading and unloading and setting a value
9. Sub-screen which is activated on pressing info button

As discussed in the previous section SCADA systems are manual in nature, the user can set the key to AUTO and input values for setting motor speed and to parameterize proportional constant for error signal (Kp), Integral constant (Ki) for eliminating steady state errors and Differential constants for preventing rapid changes (Km).  
The PID tuning is a crucial process which can be a collective determination of dynamic and desired control objectives.

WEB BASED CONTROL

The web-based control system operates through a client user, a web server, and an internet connection, enabling real-time access to a laboratory setup. Multiple clients can access the web server concurrently to peruse information pages and lecture notes pertaining to the laboratory. However, access to the actual laboratory equipment is restricted to one client at a time, safeguarded by password protection. Lab sessions are scheduled throughout the week between 6 AM and 12 PM, in intervals of 30 minutes, offering users flexibility in selecting suitable time slots. Student registration is obligatory, necessitating their student number and password, stored within the web server database. Session durations can be tailored to suit the length of experiments. Access to the lab is facilitated through a URL address, activating the web server application and SCADA smart access feature. Data exchange between client and server occurs via the Request-Response method over HTTP, utilizing the Ethernet interface for connection and data transfer. Information pages cover various aspects of the laboratory setup including the PID controller, inverter, AC motor, PLC, and SCADA, with detailed explanations accessible through specific links. Web page development is executed using Visual Studio with ASP.NET. Experimental data gathered by SCADA is stored in a database and can be exported to CSV format for further analysis. Teachers possess access to all students' experimental data, while students can only retrieve their own. The web interface offers a view mirroring the SCADA screen in the laboratory setup. Students can select operation modes (MAN/AUTO) and motor direction before commencing experiments. Trend views exhibit real-time data such as voltage, current, speed, and frequency. Students can apply a magnetic powder brake controlled by the PLC to load the motor, monitoring changes in motor current. Inverter output frequency facilitates motor speed adjustment. In AUTO mode, students can observe the impact of PID parameters on control. Additionally, menu buttons on the web page allow adjustments to features such as disconnecting, options, and clipboard management.

Evaluation:

1. Tools which implement SCADA can perform activities and experiments at least before a in person hands on experiment in the lab for the best results
2. The act of nullifying common errors like connectivity troubles, and human errors for misreading values
3. To understand Lab experiments in without time constraints and freedom to access it anywhere and anytime.
4. Not only the educational sector benefits out of PLC and SCADA but mainly implement in industrial automation to create user friendly interface to interact remotely.
5. Thus, in brief remote performance trails on Labs and experiments before performing it hands on can enhance learning process

Conclusion: