Remote Monitoring of PLC- Scada based Industrial Processes using GSM Technology

R. K. Glisten,
P.G Student,
Department of Electronics and Instrumentation,
Velammal Engineering College,
Anna University, Chennai.

A. Lakshmi Sangeetha,
Assistant Professor,
Department of Electronics and Instrumentation,
Velammal Engineering College,
Anna University, Chennai.

N. Bharathi, Ph.D
Professor
Department of Electronics and Instrumentation,
Velammal Engineering College,
Anna University, Chennai.

ABSTRACT
In process industries, field buses have dominated the connection establishment between sensors, actuators and controllers. In large scale industries the number of sensors and actuators are greater in number where wiring of such components to the controller involves higher installation cost. Ageing of cables also pose as a great disadvantage as the quality of the cable erodes day by day. In order to overcome this problem a wireless communication can be chosen as an alternative. In this project the Global System for Mobile Communications is chosen for the wireless communication. SCADA stands for Supervisory Control and Data Acquisition, this software provides the necessary details about the process information with animations wherever needed. Continuous monitoring of the process can be done through the SCADA software by interfacing it with an industrial modem which could update us continuously about the process parameters. Upon interfacing, messages will be sent to the corresponding registered mobile number through short message service. The time delay between the instant at which the parameter is actually read and the instant at which the message regarding the parameters reaches the mobile is studied.

General Terms
Cascade, PID, Controller, SCADA.

Keywords
Toolbox

1. INTRODUCTION
Wireless communications, considering many factors, are the rapidly growing segment in the communications field. Due to such reasons media has been strongly attracted and diverted all the eyes towards it. Cell phones have been gaining tremendous popularity since the last decade. At present, there are approximately more than two billion users all over the world. In fact, cell phones are shaping themselves as a business tool and an essential segment of daily routine life in most developed countries. They are uprooting the old conventional cable systems in more number of developing countries. Supporting to that, wireless local area networks (LANs) currently either supplement or substitute wired networks in many homes, industries and institutions. Innovative applications, like networks containing wireless sensors, highway automation, industrial applications, home applications and appliances are developing as high value subjects from simple test subjects. The exponential growth of wireless devices coupled with the spreading popularity of laptops and palmtops clearly visualize a bright future for wireless networks, both as independent systems and as a division of a larger networking facility. Despite so many advantages of wireless networks, many technical hurdles remain in building a reliable wireless networks that delivers the requisite performance to support developing applications.

2. CASCADE CONTROL PROCESS DESCRIPTION:
The experimental setup is designed to implement the advanced computer control methods which are used in complex processes in the process industries. Various experiments for example, cascade control, level and flow can be configured accordingly and tested with the setup. Basically, a cascade control scheme consists of two loops namely primary and secondary loop. Here the primary controller of the primary loop will be responsible for the level control and secondary controller of the secondary loop will be responsible for the flow control. The primary and secondary controllers will be working based on a PID algorithm.

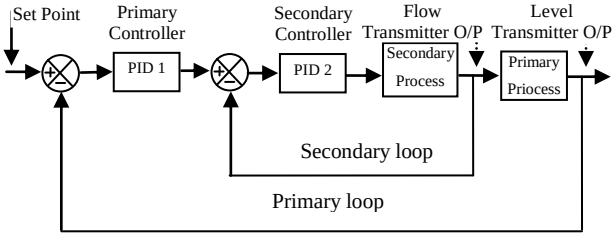

Fig 1: Computer control of process

The above diagram shows a simple representation of the cascade design being used. For any cascade controller the secondary loop or the inner loop must be contained with lower delay period to help primary control loop or outer loop to produce necessary control action. Thus the requisite care has been taken to design the PID algorithm for the cascade controller.

3. OVERVIEW OF SCADA-PLC
SCADA (supervisory control and data acquisition) is a type of control system in software. Most of the control systems in industries are computer controlled systems that monitor and control the real time processes in industries that exists in the physical world. SCADA systems steadily differentiate themselves from other control systems by being large scale processes that can include many numbers of sites and cover much distance. The type of PLC chosen here is 1762 MicroLogix 1200 Controllers. It contains isolated RS-232/RS-485 combo port for serial and networked communication.

Provides four latching or pulse-catch inputs and four interrupt inputs and also includes built-in independent 20 kHz high-speed counter. Offers Programmable Limit Switch function, provides program data security and supports floating point data files.

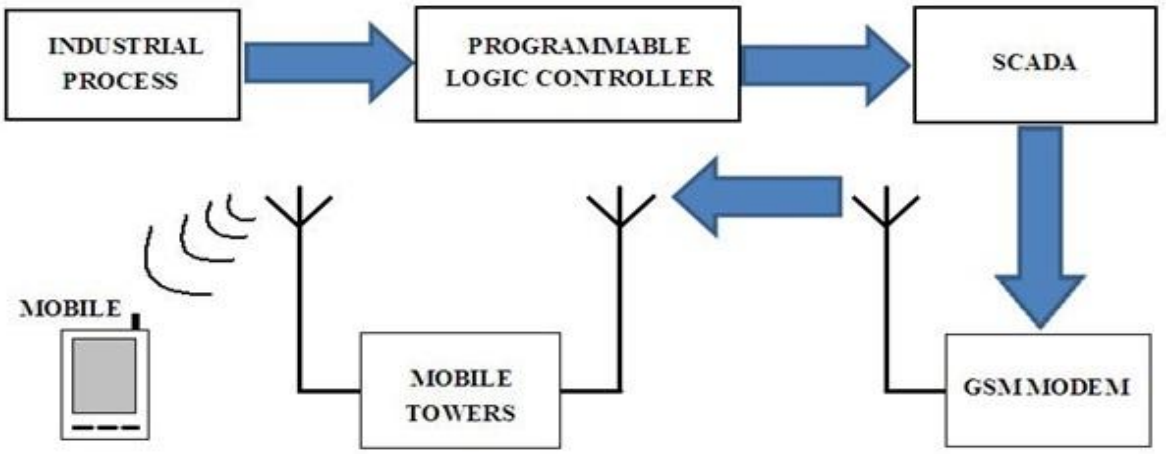

Figure 2: Block Diagram

The above diagram shows a simple model of the proposed project.

The PID algorithm for both primary and secondary controller is programmed into the programmable logic controller using ladder logic programming. Necessary inputs will be obtained from level transmitter and flow transmitter. The input leads are connected at the input section of the PLC which bears specific address for each and every input terminal and so is the case with output too. These addresses are noted down for sake of ladder logic programming. The ladder logic program can be designed according to the specific necessary cascade control scheme. The control scheme may vary for each and every industrial process. To monitor the industrial process on a computer screen a graphical representation of the process is needed, which could possibly provide control facility too. One such tool is Supervisory Control and Data Acquisition (SCADA) software, which is designed by Rockwell Automation.

Each and every object which is being created in SCADA screen can be tagged using a tag name which is created in the tag database. Tag Database maintains a list of tags which are configured with an address, which could be either input address or output address from the PLC. These addresses are continuously monitored by the SCADA to provide a continuous real time representation of the process.

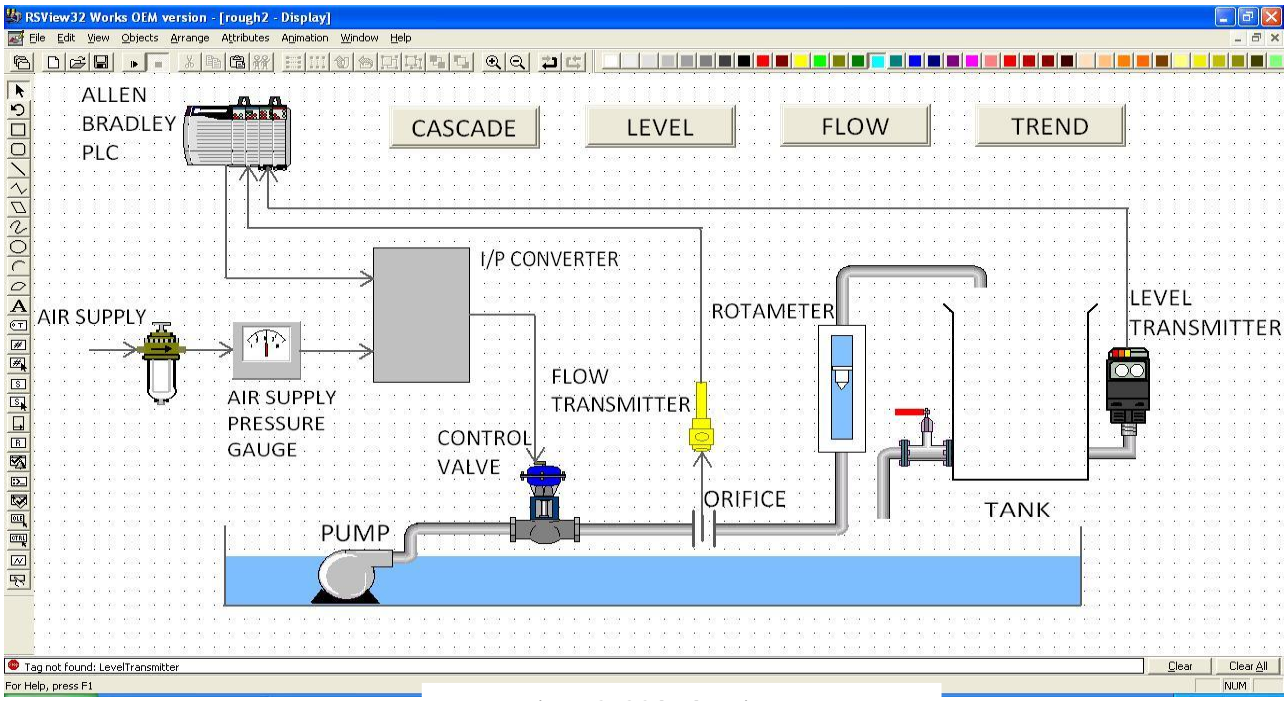

Figure 3: SCADA main screen.

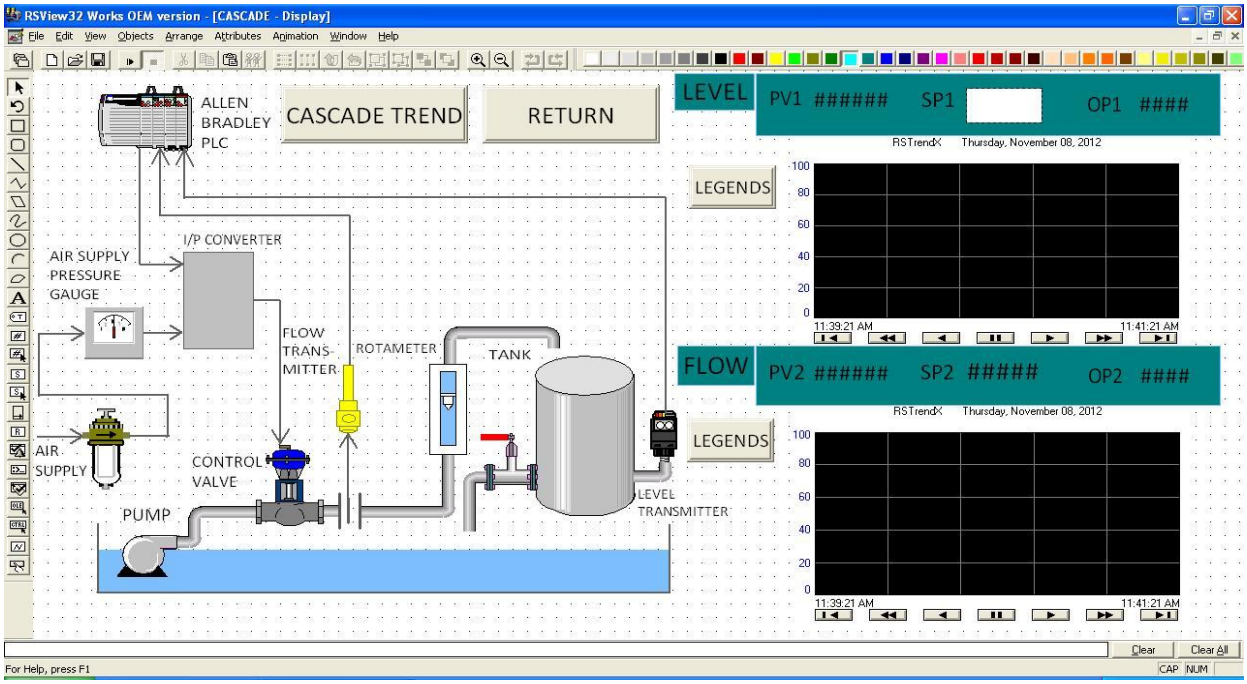

Figure 4: Cascade SCADA screen.

3.1 Implementation of SCADA for the Process

The greatest advantage of SCADA software is the ability to design any given process and it is not restricted only to processes. A SCADA screen is shown in the figure 3 and figure 4 which has been designed specifically for the cascade process. A graphical representation of the process is created exactly as it functions in the real time. For objects which needs animations, choice of animation can be chosen from the respective toolbox. To implement the animation successfully it is necessary to configure tags accompanied by addresses. For example, consider the animation of the water tank, to indicate the level in the water tank we will have to assign the address of the level transmitter which is connected to the PLC. In order to that we should interface the PLC ladder logic program with the SCADA which could be done through RSLinx classic provided by Rockwell automation. The graphs and data logger can be acquired from the RSView ActiveX control palette and RSView data logger. Graphs should be configured with necessary pens which are nothing but representation of the tags, for example Set Point and Process Variable. Each and every pen can be assigned with different colors to differentiate it from one another just to make it easy while making observations.

There are needs to monitor to certain tags directly; it is possible to do so by assigning those tags to the tag monitor. Many numbers of tags can be assigned to the tag monitor thus making it easier to get readings at very short instant of time. The values of each and every tag in the tag database are stored in a data logger folder. Even security for the SCADA screens can be created by creating username and password facility. This ensures that none of the unauthorized personnel are allowed to modify any of the SCADA screens.

4. OVERVIEW OF GSM

RADIO PERFORMANCE:

The frequencies with which GSM0308 can operate are 850/900/1800/1900(MHz). The frequencies which are used extensively are 850 MHz and 900 MHz. This GSM comes

Figure 5: GSM Modem

under Class 4 when talk is about transmission power, which is 2W at 850/900 MHz.

INTERFACE:

Some of the host protocols which are compatible with this GSM are AT commands, UDP (User Datagram Protocol) API (Application Programming Interface), CMUX (Converter + Multiplexer), and PPP (Point-to-Point Protocol). Among these protocols AT commands are being used in this project. Internal protocols are PPP, UDP API, TCP API, UDP and

TCP (PAD). Some of the API control/status is AT commands, UDP API, TCP API, AT commands over SMS.
Very widely used functionality of any GSM is short message service (SMS). Short message service has following methods Text, PDU (Protocol Data Unit), MO/MT, Cell Broadcast. Power details are 3.3-4.5V DC voltage.

4.1 GSM Functionality

The GSM has been programmed using Cscape software to facilitate the messaging service. By using Cscape we can determine what message we would like to receive, what are the parameters which we would like to monitor, etc. The messages will be delivered to the mobile number which has been specified in the program while configuring. Multiple mobile numbers can also be given and all the mobile numbers would receive the same message. Even groups can be created under which a set of mobile numbers can be assigned.

Message updates can be given a delay period as to when we would like to receive the message (i.e.) at what periodic interval. Message updates delay can be given in seconds, minutes, and hours or even for a period of days.

5. RESULTS AND DISCUSSION

An experimental test has been conducted by using the GSM which is compatible with the PLC. The desired message which was configured by using AT commands was received as shown below.

CASCADE PROCESS

PRIMARY_ LEVEL

PY_COP 100
PY_PV 36
PY_SP 80

SECONDARY_FLOW

SY_COP 100
SY_PV 70
SY_SP 100

The same message which was received in the mobile is shown in the figure 6. The output screens of the SCADA are shown in the figures 7 to 9.

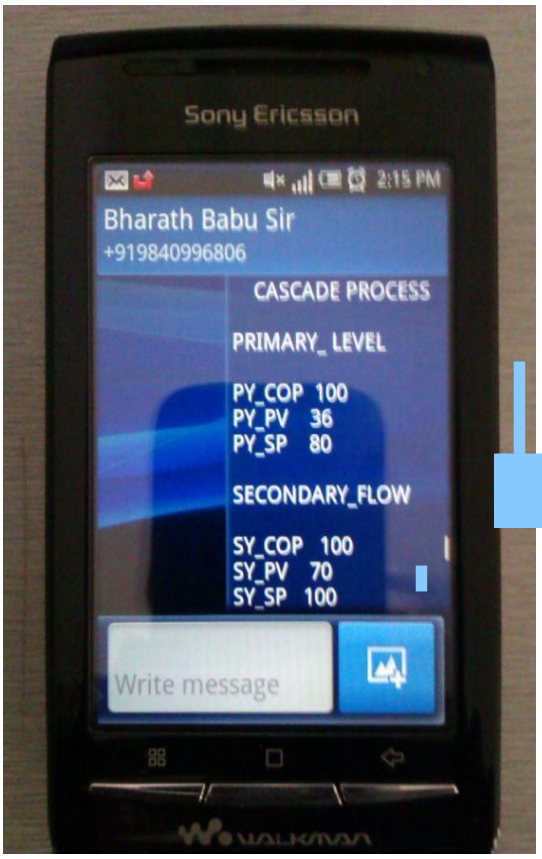

Figure 6: Text Message received from GSM Modem

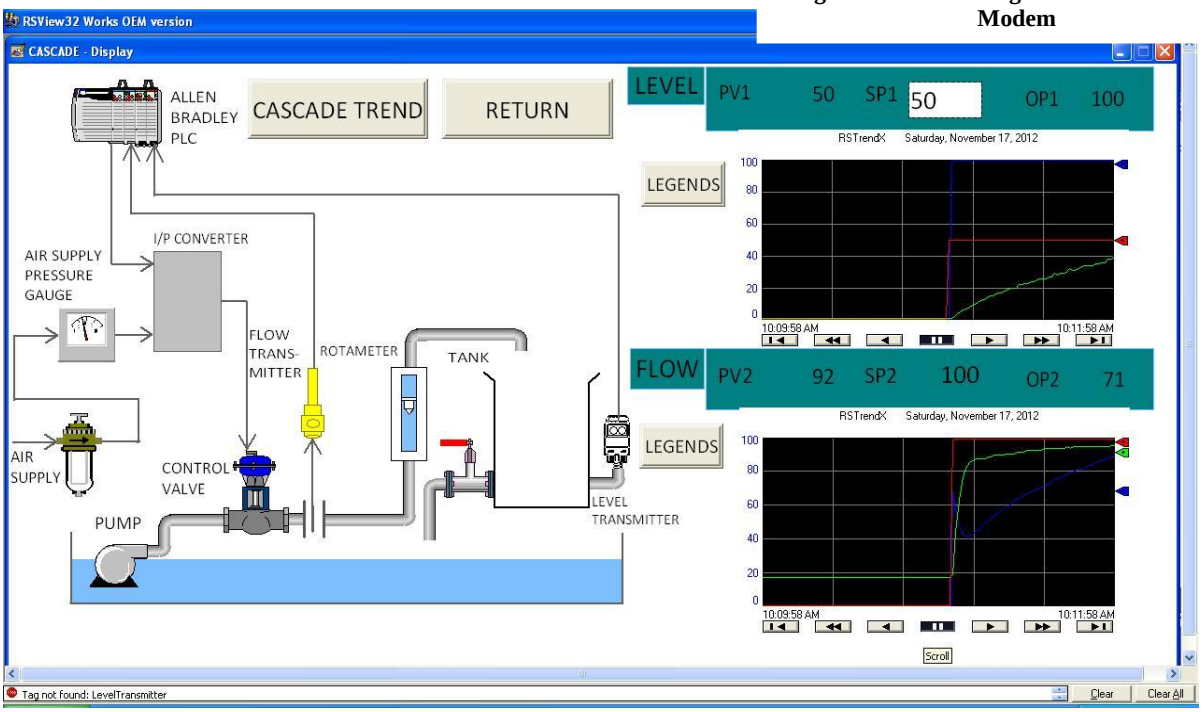

Figure 7: SCADA output screen.

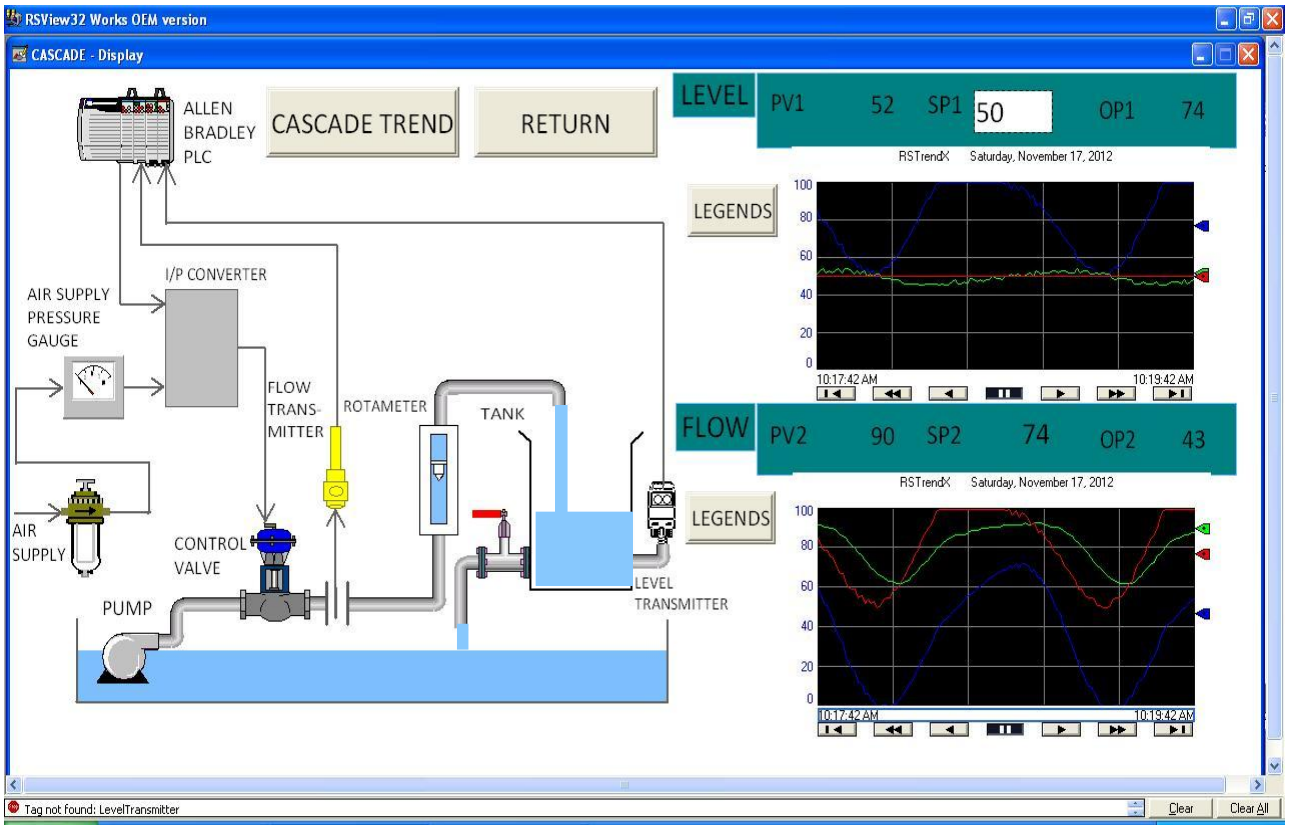

Figure 8: Cascade Output Screen

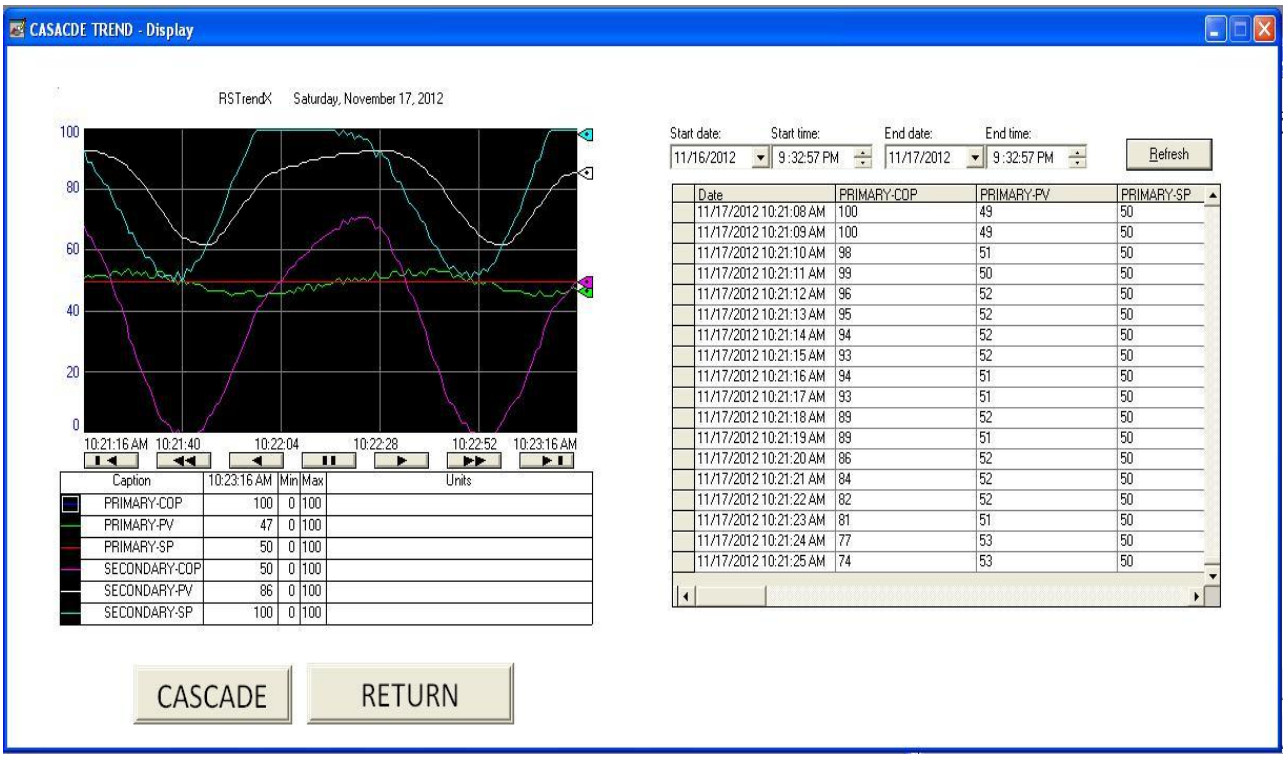

Figure 9: Cascade Trend Screen

6. CONCLUSION

This project effectively promotes high portability and provides a simple way to monitor the process on the go. The proposed project is completely safe from unauthorized personnel as security username and password are provided to ensure processes' safety. Practically there would be time delay in message services which could be not more than two to three seconds. The main factor holding the project up straight is the modification and development which could be made possibly with available resources.

7. FUTURE DEVELOPMENT

The processes could also be viewed in LabVIEW by making necessary interfacing works with the SCADA. It is also possible to view the process graphs and desired specific parameters on a android device by developing an application dedicated for the process.

8. ACKNOWLEDGMENTS

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