

USING THE SUPERVISORY ELIPSE E3 IN DISTANCE EDUCATION

Marcelo Macedo, Rinaldo Pismel Franco

Tupy Superior Institute, Educational Society of Santa Catarina, Albano Schmidt Street, 3333, Joinville, Brazil

Fernando Ostuni Gauthier

Department of Knowledge Engeneering, Federal University of Santa Catarina, Florianópolis, Brazil

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Abstract: The aim of this article is to present a method to control a didactic bench containing a frequency converter, a programmable logic controller PLC and an electric motor. To achieve the proposed objective, a computer equipped with surveillance software and a digital camera control these devices, making it possible to view and track all actions that occur on the bench. The bench controller computer is connected by internet to other computers, physically far from each other, and has a communication software that allows remote users to monitor and interact with processes running on the bench. This method opens the opportunity for distance learning, where students can interact with remote experiences and no longer as a passive user.

1 INTRODUCTION

The realization of practical engineering classes on the use of frequency inverters, PLC (Programmable Logic Controller) and induction motor require complex, expensive and scarce laboratories.

This article shows that through broadband technology offered by telephone operators, via ADSL (Asymmetric Digital Subscriber Line) to access the internet, it's possible to control and to visualize processes generated by inverters, PLC and induction motors that are physically distant from the controller.

To achieve this, supervisors commercial softwares widely used such as Elipse Scada E3 (Elipse, 2010) or Labview must be applied. These softwares control a didactic bench containing an inverter PLC (Programmable Logic Controller) and an induction three-phase motor. To watch the bench a digital video camera is necessary. The whole process is controlled using the internet with the utilization of internet Elipse E3 Scada modules.

2 WORKING PROPOSAL

Due to the difficulty of having adequate laboratories

in locations outside of educational institutions, a system in which the teacher, even outside his lab can control and display devices is being developed.

This approach is also adequate to distance education systems in which the students can have access to the costly equipments such as controllers, motors and drives, among others.

There are several alternatives to implement distance learning such as video conferencing systems via ISDN (Integrated Services Digital Network) or IP (Internet Protocol), and more recently the social networks and sites such as Orkut or Twitter or even several applications such as Microsoft's softwares.

The teacher, therefore, may use the system as a classroom anywhere needing only to have a computer with Internet access. Students will be the main beneficiaries; they may interact with the mentioned features, performing practice and seeing situations in their homes or in the classroom, provided you have Internet access. In figure 1 is shown the simplified scheme of work. (Prado Junior, 2008).

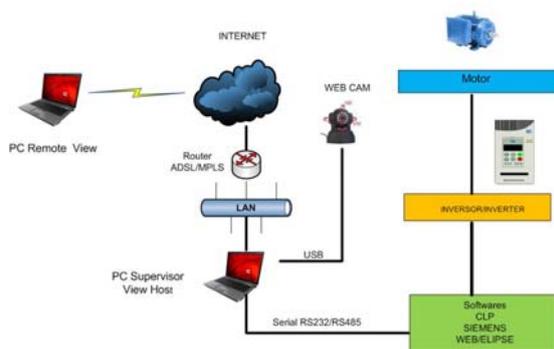


Figure 1: Simplified scheme of work.

3 METHOD USED

The didactic bench shown in figure 1 consists of a controller Siemens S7-300 model, a WEG CFW-08 inverter and a motor WEG three-phases as well as an ADSL to 1.5 Mbps, Fixed IP and a microcomputer, where the software Elipse Scada is installed. A digital camera with USB for visualization is attached to the computer. Tests are performed, so that through the Ellipse, it is possible to control the PLC (Programmable Logic Controller) and, consequently, the devices (motors and drives among others) via the Internet using the Symantec's software Pcanywhere (Symantec, 2008) or VNC (Virtual Network Control).

In order to better detail the operation of the didactic bench, the article discusses first, how the software ellipse E3 works, its components and the E3WebViwer. In the following section describes the operation of the digital camera, and soon after, the frequency inverter. Later, is approached the Controller SIEMENS S7-300 and the description of the experiment. Finally shows the expected results and the conclusions.

4 DIDACTIC BENCH

4.1 Elipse E3

The software currently used is devoted to network operation of distributed applications, enabling the applications development and connectivity with devices and other applications.

This software makes possible communication with devices for data acquisition and control manipulating this information in various ways. It also includes the creation of a graphical user

interfaces as well as alarms verification, databases actualization, information exchange between different software and other components. The tasks can be done on a single computer, local network or the Internet.

The E3 is the newest product of the Brazilian company Elipse Software, in field supervision and control systems. It is a complete system for data acquisition and control, based on modern concepts of connectivity, scalability, reliability and flexibility demanded by the market.

It is the result of years of R&D activities that construct a system whose architecture is distributed and the networked operation completely transparent, among other features.

The system is adopted by many companies inside and outside Brazil, and ensures the solution to the different fields like electrical systems and energy, pharmaceutical and food industry, petrochemical industry, manufacturing and sanitation and also in intelligent buildings.

Its application uses object-orientation, which reduces programming time and maintenance of applications. The E3 allows communication with various protocols and equipment from different manufacturers, indispensable feature for today's automation systems, and can be applied to both the local systems, and geographically distributed systems. E3 still uses proprietary client-server transparent network architecture which makes it unnecessary to copy the application between hardware stations. Besides these features, the ellipse has several other features related to its efficiency:

- Has robust servers that collect, process and distribute data in real time;
- Has independent operation interfaces, thin clients, that allow applications viewing through the E3 Viewer, Terminal Services, Internet Explorer or any browser that supports files of type ActiveX;
- Is fully prepared to work on the Internet;
- The license includes over 3000 symbols and vector graphics;
- Allows on-line configuration;
- The database is open, ie: not work with proprietary formats;
- Has complete alarm management and powerful reporting tools;
- Accepts applications OPC (Ole for Process Control) client-server;
- Support for ActiveX components;
- Redundant servers' easy configuration;

- Allows integration with other enterprise systems such as ERP and similar systems such as MONTH and Eclipse SCADA;
- Eclipse ensures system upgrades and even then, an application created in a version can run on other older versions or higher without the need for conversions and
- It is based on open industry standards such as COM / DCOM, ActiveX, Visual Basic Scripting, Windows NT/200X/XP, OPC and SQL, among others.

4.2 Components of Elipse E3

The Elipse E3 is composed by three softwares:

- E3 Server is the server application system, where all data is managed, communications are processed, and information requirements are sent to any network client. It was designed to run on operating systems Windows Vista, XP and 2003 (32 and 64 bit);

- Studio E3: it is the only application tool. It have on a modern setting environment, with icons for easy identification, making shorter the programming time. The Studio E3 allows a single application to be edited by multiple users simultaneously using multiple E3 Studios or even several E3 Studios connected to the same server, each using different configurations. This component is designed to run on Windows Vista operating system, XP and 2003.

- E3 Viwer: this is the applications generated by E3 Studio viewing and operation environment. It allows to view an application on any client computer connected to the network or via the Internet using a browser and an application called E3WebViwer. In any case, is not necessary to install the application on the client machine due that all components are downloaded from the server E3Server and recorded automatically.

4.3 E3 Webviewer

The E3WebViwer is an ActiveX component whose functionality is to have a browser that supports ActiveX controls behaving as E3 Viewer, allowing viewing and controlling applications via the Internet. The only assumption is that the client has permission to access the server E3.

Once installed, the WebViewer works as the viewer, by downloading all the elements of the application for the client in operation. Importantly, all the features of E3Viewer are supported, such as alarm management, access to data bank, historical trends, etc.

5 CAMERA CONTROL

To control the camera DC servo motors are used, which are a special type of motors, characterized by their capacity to fix itself, immediately, at any position within its operating angle.

The servo has three electrical connections: Vcc, GND and input signal. The wiring diagram of the motor is shown in figure 2.

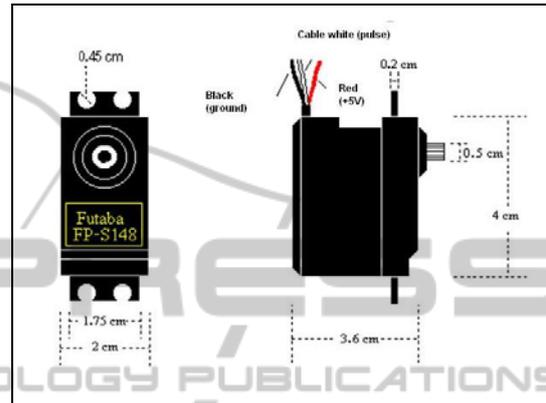


Figure 2: Servomotor Futaba S148 3003 (Sabereletronica, 2010).

The servo Futaba 3003 S148 has a torque of 479 grams / cm. This means that with a pulley, gear or arm of 2.5 cm radius, attached to the shaft of the servomotor, he will be able to lift up to 1200 grams.

The control of a servo merely indicate what position it should be located. These "orders" consist of a series of pulses. The duration of the pulses indicates the angle of rotation of the engine. Each servo has its operating margins, which correspond to the lengths of the pulse maximum and minimum. The controller programming was developed with the help of software Siemens Simatic, as shown in figure 3. (Prado Junior, 2008)

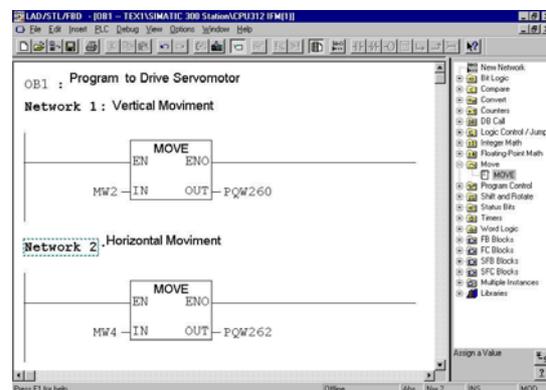


Figure 3: CLP Siemens programming.

Programming is easy to implement, because the majority of controls are already being performed by the monitoring software, like the return of the camera to the point of origin and the functions on / off this. Thus, the programming was based on the value set of sliders (scroll bars), which are in supervisory screen, on the analog outputs of the PLC. This was achieved through the use of block scheduling "MOVE", placed at the entrance of the memory corresponding to X and Y movements of the camera and the output of the block, the analog output of their every move so that the servomotor moves, with a necessary circuit pulse generator, which was developed in a circuit PWM (Pulse Width Modulation), shown in figure 4. (Prado Junior, 2008)

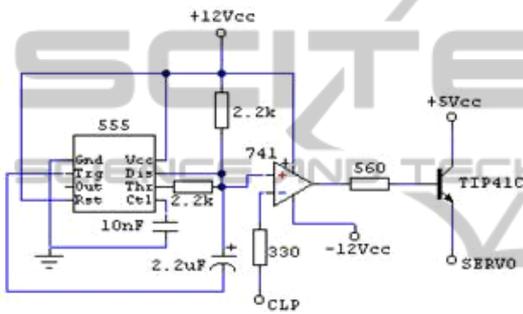


Figure 4: PWM Circuit.

This circuit provides at its output a wave of type-toothed saw.

6 FREQUENCY INVERTER

The frequency inverter CFW-08 has in the same product a V / F (scalar) and sensorless vector control (VVC: Voltage Vector Control) programmable.

The user can choose either method of control, according to the application. In vector mode operation is optimized for use in the engine resulting in better performance in terms of torque and speed regulation. The function of "Auto-Tuning", available for vector control, allows the automatic adjustment of the parameters of the inverter from the identification (also automatic) of the parameters of the motor connected to the inverter. The V / F (scalar) is recommended for simpler applications such as the firing of most pumps and fans. In these cases it is possible to reduce losses in the motor and inverter using "Quadratic V / F", resulting in energy savings. The V / F is also used when more than one motor is driven by an inverter simultaneously (multi applications).

There are two versions of the CFW-08: a standard version that has the control board with connections to the signal and control functions equivalent to old line μ line, and CFW-08 Plus version that has an additional analog input (two analog inputs in total) an additional relay output and an analog output. The general scheme of the system is shown in figure 5. (WEG, 2008)

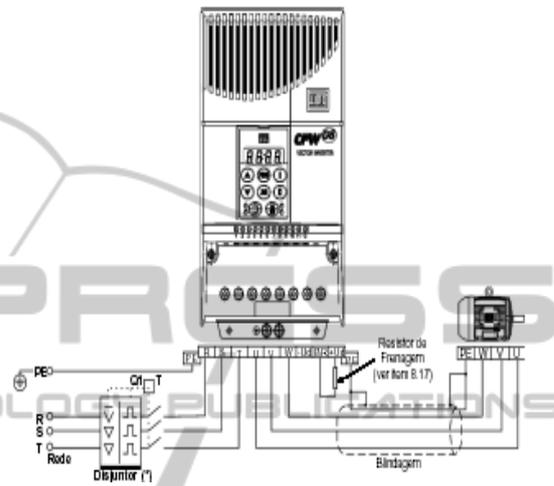


Figure 5: General scheme of the system motor-inverter.

To interface the frequency inverter with controller S7-300 was developed a relay board that drives the control points on the inverter, allowed control and the departure of three-phase motor. (Prado Junior, 2008)

7 S7-300SIEMENS CONTROLLER

With a modular architecture the S7-300 provides space-saving, configuration flexibility and rapid expansion. The PLC S7 300 requires no pre-defined numbers of slots (slot position) to be mounted. The assembly is inserted and screwed on a standard rail. The modules are interconnected to one another via a bus that becomes embedded in the track.

A wide range of CPU's are available for simple applications or high performance. The CPUs enable short cycle times, up to 1 μ s per binary instruction. There are also compact CPU with I / O's (inputs and outputs), technology functions and communication interfaces already integrated. The variety of expansion modules allows adaptation of the setting for different types of application.

Are available:

- a) Modules I / O's - digital, analog;
- b) Communication Modules: AS-Interface

(master), Profibus DP/FMS, Ethernet, serial ponto-a-ponto, Modbus;

c) Function modules (FM) - fast counters, fast pulse outputs, position control, motor stepper control, closed loop control. In a centralized configuration can use up to 32 expansion modules. Expansion modules for S7-300 are also used at the station I/O distributed ET200M.

d) Communication - In addition to several communication modules that can be added to the configuration, the S7 CPU 300 has an MPI port, through which it is programmed and parameterized. (Siemens, 2003)

8 THE EXPERIMENT

The student or teacher in possession of a computer can access the software Elipse E3 from anywhere in the world.

On the student or teacher computer the remote control configuration must be set and on lab computer the host configuration one.

The access to the computer where is installed the Elipse E3, which has control of the PLC through an application developed is done by using login and password.

With the application of the Ellipse Watcher is possible visualize by one or more camera, all devices controlled by PLC (Programmable Logic Controller).

The software currently used in the work is devoted to operating a network of distributed applications, offering a graphical interface and a new and flexible architecture that enables rapid application development and good connectivity with devices and other applications.

It is also possible to communicate with many devices, data acquisition and control, and manipulate this information in various ways, including creating user graphical interfaces, both within a single computer, local network or the Internet, in addition to alarms verification, recording in databases, exchange of information between different software and other components, besides reporting.

It is expected that the student can control various applications and devices designed to operate the inverter, change parameters of engine operation, and on the same screen of the Ellipse, control the camera position.

The use of didactic bench also prepares the student for the use of these technologies in every day activities like the control of remote stations via the internet.

The proposed didactic bench will be constructed and the application using Elipse E3 developed.

Three practical engineering classes on the use of frequency inverters, PLC (Programmable Logic Controller) and induction motor will be designed.

A group of students will be required to accomplish these experiences. The success of the students in reaching each experiment goal will be evaluated and use as indicator of the didactic bench utility.

9 CONCLUSIONS

The ultimate goal of this work is to assist in training of skilled professionals in more remote geographical locations.

To implement the proposal of this article, supervisor commercial software - Elipse Scada E3- is used needing only a room with computers, resources to support teaching and basic internet access to broadband.

The implementation feasibility of a didactic bench comprising inverter, motor and PLC, will be shown and its acceptance by students evaluated in a future paper.

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