Teaching Automation Using Real PLC'S and Virtual Factories

Faculty Paper
Innovations In Engineering & Engineering Technology Education and Curriculum Development

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1. Abstract

It is a need to teach students in Engineering by showing the machines and tools used in industry, this can be accomplished by buying equipments and putting them in the labs, through field trips or creating virtual factories.

The need to control the machines is accomplish by using PLC's especially in Industry. By using PLC to control cells and factories a higher level of Automation is introduce.

The information revolution, which began in the late 20th century, continues to gather pace, driven by spectacular advances in electronics, computing and communications. The automation is following and surpassing the information technology with the spectacular technological changes.

2. Why we need automation

In the race to keep up with growing demand and increasing market share, profitability depends on time to market, plant efficiency and controlling your overall cost.

The continuing need for increases in productivity and profitability has demanded that any introduction of automation must give a high level of efficiency and reliability to ensure a quick payback on investment.

Automation has two purposes that are closely related:
1.) Improving customer service
2.) Ensuring the survival of the enterprise

3. Automation

In industry, Automation can be defined as a technology concentrated with the application of mechanical, electronic, and computer-based systems to operate and control production.

Automation can be separated into two categories:
1. Automation of the manufacturing systems in the factory.
2. Computerization of the manufacturing support systems.

Example of automated manufacturing systems include:

- Automated machine tools that process the parts
- Transfer lines that perform a series of machining operations
- Automated assembly systems
- Manufacturing systems that use industrial robots to perform processing or assembly operations
- Automatic material handling and storage systems to integrate manufacturing operations
- Automatic inspection systems for quality control

In the home, automation may be something as simple as remote or automatic control of a few lights. For others, security may be the central application. Still others may choose to install advanced controllers or use voice recognition. As a very basic definition, we tend to refer to home automation as anything that gives you remote or automatic control of things around the home.

In software, automation is a COM (Component Object Model**)** -based technology that enables dynamic binding to COM objects at run time. Automation was previously called OLE Automation and ActiveX Automation. An ActiveX (OLE) term that refers to a means of manipulating another application's objects by the use of a programming language, most commonly Visual Basic for Applications (VBA). Object Linking and Embedding (OLE) is a Microsoft technology which allows you to link elements from different applications within each other

4. Levels of Automation

There are five levels of Automation

1. *Device level*, the lowest level it includes the actuators, sensors, and other lower devices.
2. *Machine level*, the hardware from device level is assembled into individual machines.

3. *Cell or system level*, a group of machines or workstations connected and supported by a material handling system, computer, and other equipments needed for a manufacturing process.
4. *Plant level*, it receives instructions from the corporate information system and translate them into operation plan for production.
5. *Enterprise level*, the highest level it is concerned with all functions necessary to manage the company: marketing and sales, accounting, design, research, aggregate planning, and master production scheduling

5. PLC's in Automation

The PLC is the hart of Automation it is used in machine level (CNC machines), Cell level, and Factory level. For this teaching PLC's must take place in any Automation program for the students to be able to run and change the configuration of the factory floor. The University environment is limited by space and money so it has to find other methods to bring the factory floor inside the classroom. One of the methods is using virtual cells. One of the software's used in Fairfield University is Delmia Automation, it is used to create the cell and then control the cell with a PLC.

6. Real PLC and Virtual Factories

In the PLC class the students start from device level (connecting sensor and actuators to the PLC) then controlling premade cells. In CAM (Computer Aided Manufacturing) class the students learn SolidWorks and get introduced to Catia so they are able to design their own cells in Delmia. Then in the PLC Class the students build the cell and create the PLC programming then check their PLC programming.

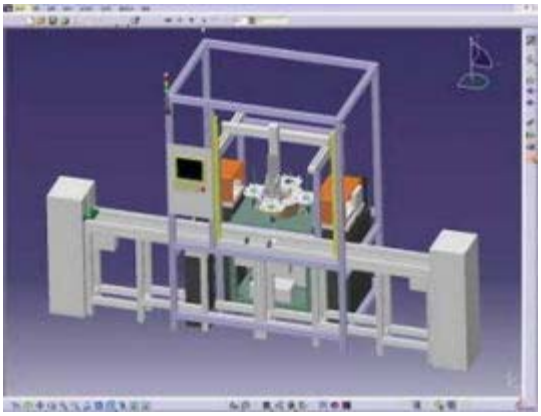

Fig 1. Example an Assembly Cell in Delmia Automation

After the cell is completed and the students setup the sensors and actuators on the cell (all the movements a the machine can make) the PLC programming is done. The following is picture is showing the connection to the PLC through OPC. (See Fig 2.)

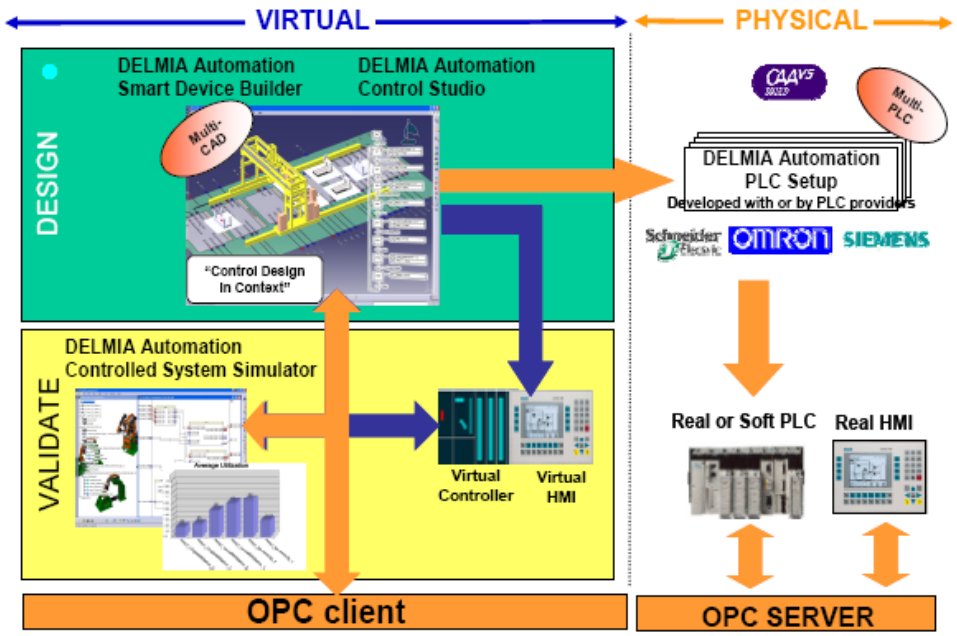

Fig 2. PLC Connection to Delmia Automation
(courtesy of Delmia Automomation)

This helps the student to uncertain the connection between the mechanical design and control engineering so they will be able to help in designing the machines (cell) and also programming the PLC.

7. Benefits of teaching Automation courses and introducing Virtual Factories

The biggest benefit for the students is that they find local jobs. Companies at this time are looking to Automate trying to reduce they cost ant to be able to compete in this world wide economy so they are hiring our Automation students and students who took Automation classes (Ex PLC).
Companies are giving grants to Fairfield to develop the program further (Ex Boehringer Ingelheim Pharmaceuticals, Inc giving 700k).

7. About the Authors:

Cristian Craciun is an instructor and Laboratory Engineer in the School of Engineering, Fairfield University. He completed the Master of Software Engineering Program in May 2004 and he had bachelor of Mechanical Engineering with concentration in Manufacturing and Automation. HE is pursuing at this time his PhD at University of Bridgeport.

8. Acknowledgements

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9. References

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[2] Automation http://www.automation.com/