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PLC Controller Stations On A Budget

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Abstract
Engineering technology programs usually incorporate an intensive, hands-on based curriculum. Therefore, laboratory equipment becomes a vital and necessary component of technology education. With tightening budgets of higher learning institutions engineering technology/engineering programs are looked down upon as "too expensive" to run, especially in the light of typical lower enrollment than other areas such as business or English. Unlike other majors, the engineering programs do require laboratory equipment, which does not come cheap. Teaching vital skills in engineering requires rather expensive equipment set-ups. The author shares his experience of building PLC stations, in-house, which eliminated the expenditure of thousands of dollars otherwise needed for professional stations.

Keywords
Programmable Logic Controllers

1. Introduction

Engineering technology programs do incorporate hands-on oriented curriculum, which necessitates financial commitment from higher learning institutions to provide current, state of the art equipment. There is no need to mention that price of educational, professional laboratory setups is quite high, well into tens of thousand of US Dollars (labvolt, 2005). This is not pleasant news, especially for university/college administrators, who in the light of tightening schools budgets and not so rosy looking state support for higher education are looking at the cost of offered programs. The engineering and engineering technology programs are being scrutinized because of relative higher cost per student compared to other programs. Engineering education requires laboratory activity and individual attention from instructors in order to teach vital skills, which any civilized society relies on to function. Teaching engineering skills usually requires a longer nurturing and mentoring period, which also contributes to higher costs of engineering programs. In addition, the equipment has to be maintained, which is another factor affecting economics.

1.1 Engineering Technology Instructor's Frustrations

In the light of the described economics, it does not come as a surprise that engineering technology instructors are becoming more and more frustrated and feel pressured to decrease cost in the enrollment driven reality. As far as equipment-funding sources are concerned, available externally and internally, the money pot is shrinking based on anecdotal, empirical evidence.
Therefore, the author decided to be proactive and rely on resourcefulness to tackle funding shortages. Naturally, the funding is needed to keep electrical engineering technology (EET) equipment current and

properly maintained. The prices of PLC trainers manufactured by education-oriented, manufacturing companies are quite high, reaching several thousand US Dollars per station. (labvolt, 2005; advancedtechnologies, 2005). Thus, the costs were quite prohibitive. The author, after thorough research and consideration of funding limitations, decided to purchase PLC units directly from the manufacturer, Allen-Bradley (ab, 2005) through a local sale representative, and to build PLC training stations by himself. Recently, due to grant application process, the author obtained the Pennsylvania Grant for Engineering Technology Equipment, and matching funds appropriated by Penn State University and private donors from the local industry. The funds amounted to circa $13,000 US Dollars, which was inadequate for a purchase of PLC trainers from trainer manufacturers (a conservative estimate would be circa $30,000 US Dollars), but just enough to build stations in-house.

2. PLC Stations

The author decided, early on, to build two sets of stations based on Allen-Bradley Micrologix 1000 series and CompactLogix PLCs. The first one are quite low cost and robust with enough input and output ports for advanced projects, which are programmed via RSLogix 500, software that comes with the units. The second one, CompactLogix, allows for far more complex projects based on digital and analog input/outputs modules. CompactLogix are programmed via TSLogix 5000. Much greater capability comes with a much higher cost per unit.
After some deliberations, author decided to build light, rather small, portable units due to physical constraints of a limited, electrical engineering technology laboratory space. The shape of training stations was set to be of a small pulpit-like looking podiums with an easy access to input/output terminals. The main front panel is raised so that the user has a non-obstructed view of overall station. (See figure 1.) To provide sturdiness of overall structure and in order to minimize the occurrence of electrical accidents-erroneous short circuits, the author selected non-conducting materials such as wood and laminated wooden materials. This consideration came after long educational career, in which the author witnessed proverbial “the impossible” things to happen anyway in an EET laboratory activity. Namely, training stations produced by various companies have usually conductive, metal based front panel-surfaces, which are not suited very well for classroom environment. Occasionally, the accidental contacts with loose wires caused unwelcome blow-ups of the supply transformers of training stations.
The description of the materials and electrical components selected to build PLC stations follows.

2.1 Building Material and Electrical Components

To construct the training stations the author used the following building material:

- wooden studs to build a frame
- wooden planks for walls
- laminate flooring material for front panel
- screws,

and electrical components such as:

- toggle switches
- momentary switches, NO
- momentary switches, NC
- Dual Binding Posts for Banana plugs
- electrical copper wiring
- power cord,

and other:

- DIN rail guide to host PLC and other devices such as relays, etc.

The building material was purchased at a local home improvement outlet and the electrical components from Allied Ellectronics Inc. (alliedelec, 2005). The power cords were recovered from "junked," old computer systems.
The stations, pictured on figure 1, were developed to host Allen-Bradley MicroLogix 1000 PLC units. The side view, presented on figure 2, shows the same station with two relays by Phoenix Contact Company (phoenixcontact, 2005), mounted on the DIN rail guide, for possible control application. Currently, similar looking stations are being constructed to host Allen-Bradley CompactLogix units (ab, 2005). The units will have additional, second DIN rail guide to host various PLC modules as well as additional power supply and relay units (phoenixcontact, 2005).
The constructed training stations offer portability, sturdiness of construction, and flexibility in usage, vital characteristics for today's EET laboratory practice.

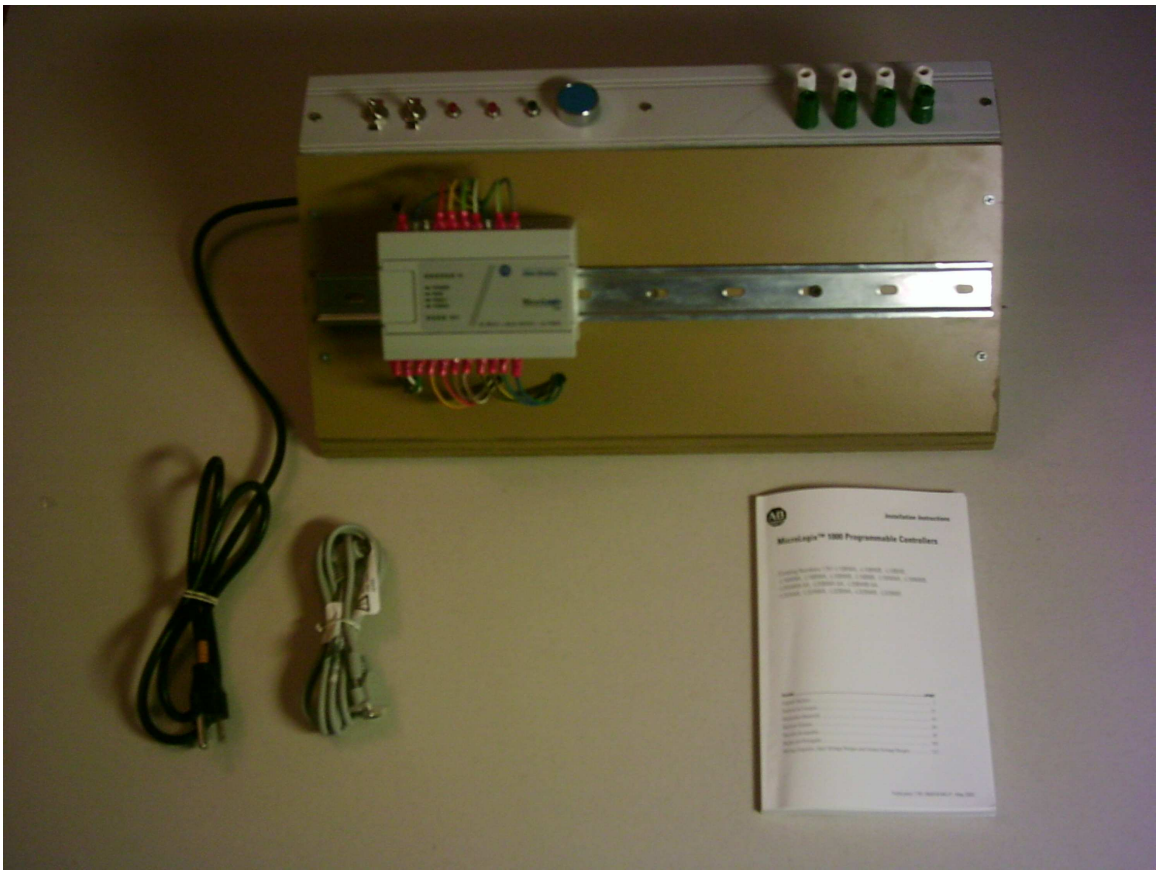

Figure 1: PLC station hosting Allen Bradley MicroLogix 1000 unit-Front View

2.1 PLC Station Dimensions

The stations have the following dimensions (see figure 1 & 2):

- Front length: 18 inches
- Depth: 8 inches
- Height: 7.5 inches
- Weight: 9 lb.

Figure 2: PLC station hosting Allen Bradley MicroLogix 1000 unit and relay units-Side View

3. Conclusion

The main purpose of this paper was to share some experiences of the author in building in-house PLC training stations. Budgetary conundrums, which universities and colleges are facing force faculty to seek new ways of squeezing the dollar even more than ever. This is particularly important in engineering technology programs where equipment has played a traditionally important role in educational instruction. The author decided to take a pro-active role and develop in-house training stations, which allowed construction of fully functional training stations on a limited budget.

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