IMPLEMENTING INDUSTRY LEVERAGE TO ESTABLISH A NEW AUTOMATION EQUIPMENT TRAINING CENTER

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Abstract-Almost all the material and goodspurchased today is packaged. Packaged containers provide ease of handling, safety and sanitation, tracking and relevant information both for the suppliers and consumers. Global market for packaged goods and material is increasingly growing. In the United States alone, packaged goods constitute about $2100 Billion where the packaging industry contributes $165 Billion and the packaging machinery equipment brings$6 billion a year into the US economy. Packaged material requires fast, accurate and reliable machinery. As more and more goods are packaged, new equipment must be purchased to package the goods. The packaging industry has transformed into a high intense technology, information critical, and high speed industry. The packaging machines employ electrical, mechanical, computer and telecommunication equipment in their design. Most of packaging machine employ automation equipment such as Programmable Logic Controller (PLC), servo motors, and Variable Frequency Dives (VFD). An engineer, who designs and maintains packaging machinery, must be knowledgeable in bothmechanical and electrical fields. In the past packaging machinery manufacturers trained their own engineers in house which took several years and many trial and error processes. The fast growth in the packaging industry requires a more systematic and scientific approach in training the engineers. Unfortunately, educational institutions have been slow in providing graduates that can work in this intense industry. As it turns out, engineering technology programs are in an ideal position to support the packaging industry.

Purdue University Calumet has established a 4-year Baccalaureate level “Mechatronics” degrees program and created advanced level courses for Mechatronics with a focus on Packaging Industry [1]. The new program is developed with a very close collaboration from packaging machinery and automation equipment manufacturers. Two state-of-the-art laboratories with the donated equipment from major packaging and automation equipment manufacturers have been established. As a result of this effort, Mitsubishi Electric has provided the technical expertise and equipment to establish a training center for students, technicians, engineers and end users to learn new automation equipment and their applications at Purdue-Calumet.This paper addresses:

- Packaging Machinery Equipment Training Center
- The Best Procedures in Establishing and Maintaining Industry & Academic Partnerships
- The first Mechatronics Engineering Technology bachelor program specifically designed to serve the packaging industry.
- The industry partnership in the development of the program, curriculum, and laboratory efforts.
- Preparing skilled work force for fast changing packaging industry

- The internship program between the industry and the Mechatronics Engineering Technology Program

Key Works: Partnership, Curriculum, Training Center, Workforce, Laboratory

Introduction:

Packaging industry is one of the fastest growing industries worldwide. To meet the increasing demands for packaged goods, new machines are designed and introduced into the market continuously. These machines are fast and contain high degree of complexity in their designs.The design of these machines requires mechanical, electrical, electronics, computer and telecommunications expertise.It is this chain of events that has driven the Mechatronics Engineering Technology program at Purdue University. Five years ago, with the support of industries such OEM and machine builders the Mechatronic Engineering technology at Purdue Calumet was established. One of the industries with close collaboration with our program is Mitsubishi Electric Automation.As one of many Mitsubishi automation affiliates around the world, Mitsubishi Electric Automation, Inc., is part of a $40 billion global company serving a wide variety of industrial markets with a family of automation products including programmable logic controllers, variable frequency drives, operator interfaces, motion control systems, computer numerical controls, industrial robots, servo amplifiers and motors, and industrial sewing machines. The philosophy of the company includes a commitment not only to providing superior solutions and service to customers, but also to contributing education and training. In order to provide training for end users several training centers has been established around the world., Solutions are what Mitsubishi takes seriously, no matter how difficult the job. Collaboration with universities can provide an avenue for technical problem solving and trainings. The facility's engineers, electricians, maintenance people, and end users must increase their knowledge to improve job performance and keep processes running smoothly. The instructors for the training centers go under stringent requirements which include many years of field experience and in-depth understanding of the product and their applications .The classes provide practical, hands-on training that can be used the moment the student walks out of the class.The collaboration between Mitsubishi Electric Automation and Purdue University Calumet, created a training center on the Purdue University Calumet Campus. The purpose of this center is to support and provide a fully equipped facilities to expand Mitsubishi University based automation product training. The

facility is equipped with five racks with PLC, motion control and networking gears. Picture of a training set up is shown in Figure-1and the details of a rack are shown in Figures 2 and 3.

Figure-1 Trainer Rack with HMI and Computer

This collaboration provides benefits both Purdue University Calumet and Mitsubishi. Purdue University Calumet is able to obtain state-of-the-art manufacturing automation products for student education, leverage industry professionals to provide real-world experiences to students, and gain training revenues and equipment.

Mitsubishi also benefits greatly from this collaboration. The Mitsubishi training capability is expanded by utilizing a dedicated training center associated with a world class university, and a pipe-line of well trained and educated faculty and students with hands-on experience. The collaboration also allows Mitsubishi to leverage the university research and development capability.

Figure-2 Trainer Rak with VFD and Servo Drivers

Figure-3 Tainer Rack with Different PLC modules

Training Center mission:

- To provide a student-centered learning environment where students, technician, engineers and end users learn the applied technical material to prepare for a wide variety ofprojects in related fields.

- To conduct training with a normal classroom structure for a group of students as well as training on individual topic, individual course, and or individuals interested in learning specific topic on automation engineering.

- To assist in providing technical assistance in design, installation and troubleshooting of automation projects and other related areas to local businesses.

Courses Offered at Training Center:

Mitsubishi University offers a wide range of training classes on various Industrial Automation products, including programmable logic controllers, operator interfaces, networking, servos, motion controllers, variable frequency drives, and robots. A brief list of these classes is given below. The training center at Purdue University Calumet is equipped to facilitate all of these classes. Currently, the first two of the following list is taught at Purdue Calumet facility.

1. **PLC Basics (GX Works2)** concentrates on PLC concepts and hardware, and is the prerequisite for the PLC programming classes. It will always be offered the day before the GX Works2 Programming class.
2. **GX Works2 Programming**, is a 3 days long, and discusses all PLC platforms.This course is intended to introduce the GX Works2 programming software and programming in ladder logic.This course covers the concepts of ladder programming, as well as the features of the GX Works2 software. The material covered will include concepts applicable to the FX Series, L Series, and Q Series programmable controller families. In most cases, different hardware options will be available to allow group of students to use the hardware platform of their choice.
3. **GX Works2 Structured Programming** is a 3 day long, and concentrates on the structured programming concepts. It will always be offered the day after the GX Works2 Structured Programming class.
4. **D75/D77 Positioning** is a 3 day class and includes information on all QD75, LD75, QD77, and LD77 positioning modules. The first 2 days are covered by the new **D75/D77 Positioning**class. The third day is allocated for **QD77/LD77 Advanced Positioning**training class.

5. **MT Works2 Programming**training class is a 4 day long class. This class is applicable for users of the QDS Motion CPU, QD Motion CPU, QH Motion CPU, Q170MCPU, and MR-MQ100.

Each course describes the materials under several Lessons. Each lesson is accompanied by practical and hands-n examples. At the end of each lesson a list of questions are provided and student must answer to those questions. The questions are being discussed and answered in the class.

Currently the PLC Basics and GX Works2 Programming classes are conducted at Purdue University Calumet facility.

Besides the training center Mitsubishi also sponsors other experimental program with Purdue University Calumet.

The detail of this project is presented in another paper [2].

Assessment:

At the end of each class a test conducted to examine the student grasp of material. When a student attend all the class sessions, performs all exercise problems and successfully pass the exam, a certificate of completion will be awarded to that student.

Mitsubishi Sponsored Program

Mitsubishi sponsors PackML Experimental Projects with Purdue University Calumet are as follows. The main objective of conducting these projects is to obtain qualitative and quantitative benefits of PackML implementation.
The elements of the PackML Experimental projects include

- Defining benefit measurement criteria;
- Converting the software of an existing packaging machine toconform to the PackML standard using Mitsubishi PackML template software;
- Measuring and documenting the benefits of PackML integration.

An actual packaging machine will be used to conduct these experimental projects. The machine currently has the automation system from a particular supplier and the machine control logic was implemented using the traditional method without utilizing PackML. The experimental projects will include the following tasks by the students:

- Determine a set of critical machine performance measures that can be used to define the effectiveness and efficiency of the machine operations, such as cycle time, simplicity of fault diagnostics, ease of operator interaction, etc.
- Collect the data based on the measurement criteria selected.
- Implement PackML States and Modes on the same machine.

- Collect the data using the same measurement criteria.
- Analyze and report the efficiency improvement of the machine.

Additional projects can also include replacing the control system with Mitsubishi control system with existing PackML template programs, and compare the advantages in implementing PackML using pre-defined templates.

Benefit of the training center on exiting curriculum:

Four laboratory experiments have been developed and incorporated in the existing curriculum for the 4-year Mechatronics Bachelor degree at Purdue Calumet. The following is the list of these four laboratory experiments. In these four experiments, the students get familiar with the Programmable Logic Controller basics, programming, digital and analog input/outputs, and special data collection cards, Variable Frequency Drives (VFD), Servo Motors and Human Machine Interface.

Laboratory Experiment-1 Introduction to Q-Series PLC Hardware and Configuration

Laboratory Experiment-2 Basic understanding of Programmable Logic Control (PLC)

Laboratory Experiment-3 Basic understanding of Human Machine Interface (HMI).

Laboratory Experiment-4 Intergradation of Motion Control to Two axis Motors through the PLC and HMI

Conclusion:

A state of the art laboratory with full support of industry was established. The mission of this laboratory is to train students, technicians, engineers and end users utilizing the latest technology in automation industry. The equipment and training material are given by industry and will be updated with new items as newer models become available. Furthermore this laboratory will provide technical assistance to local industries as it is needed.

References:

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