International Conference on Interactive Collaborative Learning

STRUCTURED ABSTRACT

IGIP/ICL CONFERENCE

Industrial Automation Self-Learning Through the Develoment of Didactic Industrial Processes

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ABSTRACT

Teaching industrial automation is a complex mission. The classical approach is based on lectures and laboratories assisted by teachers. Nevertheless, teaching industrial automation using the classical approach is not easy because this multidisciplinary area requires knowledge in control, energy, electronics, robotics and computer engineering, among others. In this way, this paper presents an approach to teach Industrial Automation based on a self learning strategy. Instead of using the classical approach, students must develop a research work and a didactic automation prototype. The results of this methodology indicate that students increase the interest about industrial automation and clarify important aspects of assembly, commissioning, parameterization and programming of electric and electronic devices. Additionally this methodology seems to increase self-confidence of students and give them the necessary background to face the challenge of working in the real world.

KEYWORDS

Industrial Automation; Didactic equipment, Self-learning

CONTEXT

This paper is dedicated to improve the skills of Electric Engineering students about Industrial Automation. This specific area of the Electrical Engineering Courses is for the students a complex task. The classical approach is based on lectures and laboratories assisted by teachers. However, teaching Industrial Automation is not easy since Industrial Automation is a multidisciplinary area that requires experience and competences in control, energy, electronics, robotics and computer engineering, among others. In this way, this paper presents an approach to teach Industrial Automation based on students self-learning. Instead of using the classical approach where students have a passive role, it is used an approach in which the roles of students and teacher is changed. In fact, students will now play an active role and the teacher the passive role. According to this, they first must propose an industrial system that can be resulted in a didactic industrial process. After the discussion of the proposed systems with the teacher and other students, they must implement it.

PURPOSE OR GOAL

The purpose of this paper is to present a methodology where the knowledge and motivation of the students regarding of the industrial automation could be improved. This methodology is based on the change of the students and teacher role. As a result it is expected that through the development of didactic equipment with industrial devices from several manufactures, students clearly understand the functionalities of specific devices and be able to handling and commissioning them as they should do in real scenarios. Usually this kind of projects are developed by students of the second course of Industrial Automation with help of teachers which have an active role. It is considered that one of the best ways to learn is to do it for yourself. At the same time this equipment is used in exhibitions and workshops were students of the second course explain the operational detail of the didactic equipment to other students. This improves the self-confidence of students and give them the necessary background to face the challenge of working in the real world. Fig. 1 shows one of the didactic industrial processes developed by the students.

Fig. 1. Example of didactic equipmentf for self-learning of Industrial Automation.

APPROACH

In terms of education about theory of Industrial Automation students are encouraged to learn different aspects, namely:

- Principles, rules and standards of electrical diagrams;
- Devices for connect, control and protect electrical installations in industrial environments;
- Most common sensors (digital and analogue) and actuators for industrial applications;
- Principle of operation of most common electric machines used in industry;
- Processes to start and stop electric machines considering operational and energetic requirements;
- PLCs (Programmable Logic Controllers), interfaces with the other devices and languages to program this devices according with IEC 61131-3.
- Fieldbuses for Industrial Automation;
- Commonly used Fieldbus standards (physical layer standard, media supported, maximum nodes, deterministic, intrinsically safe, maximum segment length, etc.);
- Other aspects…

The systems that should be developed must normally be different. Thus, some equipment is dedicated to simulate water pump systems, other is dedicated to simulate elevators or energy substations, etc. In this king of project, students must put into practice the knowledge

acquired in industrial automation and in other subjects of the curricular program. Other important aspect is to learn to work as a team and how to manage conflicts. In order to achieve this goal there are several steps. First, each group of students should propose an industrial process to be implemented in didactic equipment. The proposal should be presented to the teacher and other colleagues. After the presentation there will be a discussion in order to see if it is possible to improve the proposed system. The second step is the development of the didactic equipment. After their implementation the developed system should be tested in front of the teacher and colleagues. Finally, the systems should be used in exhibitions and workshops.

ACTUAL OR ANTICIPATED OUTCOMES

The use of laboratories is essential to consolidate theoretical knowledge in engineering. Nevertheless, in terms of education it is more valuable if students develop new equipment and to put them at the service of other students. With this type of projects students are better prepared to deal with practical problems that happens in real situations and in their professional life, increasing their self-esteem and self-confidence. Employee feedback shows that this should be a way forward in training good engineering professionals. The experience of handling and commissioning didactic equipment in the Automation and Robotics laboratories is an important training aspect of engineers.

CONCLUSIONS

The objective of this paper is to present alternative solutions to improve the interest and the skills of Electric Engineering students about Industrial Automation. It is very motivating to see new didactic equipment developed by students, showing that the effort and commitment placed in learning the contents of Industrial Automation have led to a final product that will be useful in laboratories and workshops. In addition, industry professionals outside the school seems to appreciate students with ability to solve problems autonomously and with good team integration skills. Despite the good results achieved, one of the main disadvantage of the proposed solution are the costs of the equipment, often only achieved through strategic partnerships with companies which provide some of the necessary devices.

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