THE USE OF ROLE PLAYING IN HUMAN AUTOMATION SYSTEMS

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Abstract

This communication presents a collaborative experience between four Spanish centers: the School of Engineering (ETSE) and the Sports Services Area (SAF) both from the Universitat Autònoma de Barcelona (UAB) jointly with two centers of the Technical University of Catalonia, the higher school from Vilanova i la Geltru (EPSEVG) and the higher school in Terrassa (ETSEIAT). The idea behind this collaboration is to explore the possibility of role engineering education and project development for engineering students. The basic principle of such projects is the identification of the corresponding roles associated with the different parts that can be found on current social/industrial activity.

Keywords - Automation systems, project based learning, human centred design

1 INTRODUCTION

The Role Playing is used in our work as a methodological tool to give students an appreciation of the range of issues and problems associated with requirements engineering in real settings [1]. The Role Playing strategy is a successful tool used, in example, in software engineering education [2]. In order to develop an integrated framework, it's possible to improve the relationship between the Role Playing strategy inside the educational theory of Technological Pedagogical Content Knowledgement [3]. One interesting approach is to establish a relationship between the use of the role playing tool and the realization of an engineering project.

Among all possible different engineering curricula that can be found around (see [4] for a few examples) it is recognized the value of handsome experiments and realization of project courses. Effectively, the realization of a project, usually during the last year of the degree, allows the student to face with a somewhat large problem where he/she has to be able to tackle the analysis and design stages as well as considerations on technology for implementation.

The motivation for this communication it has been to show how opportunities for real world control and automation applications can be found on the immediate environment. Section two shows the relationship between the SAF enterprise and the Universities UAB and UPC. Section three presents the results of the engineering students in the role of industrial operators. Finally, the conclusions and future lines are presented.

2 INDUSTRIAL-ACADEMIC COOPERATION

The "UAB" is a campus based university with more than 40.000 inhabitants (students, academics, staff, etc). In fact, this makes the University campus to behave like a city with some sort of facilities offered for their inhabitants. Among them, the Sports Service Area (SAF) is one of the largest and with complex installations [5].

From the evidence for the need of introducing new control elements and to integrate the different subsystems to help the SAF management staff the collaboration between both entities (SAF and the UAB Automation and Systems Engineering Group) has emerged (see Fig. 1). The interesting point is that we decided to develop the collaboration under the form of engineering projects for undergraduate students.

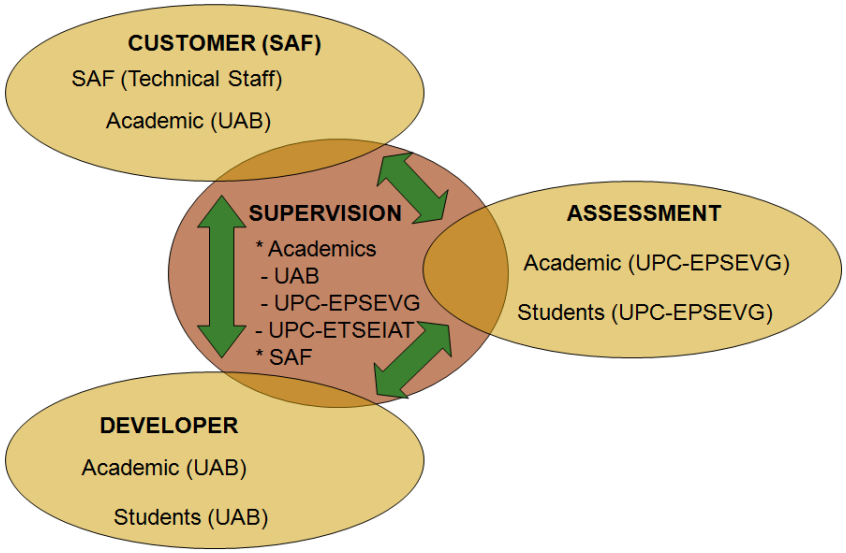

Fig. 1 Interaction between partners

Each academic year, before summer, it is time to prepare the engineering projects to be developed during the next year. This way the students can look at the different offers and apply for one. From the SAF management a list of automation and control problems is first elaborated. From this list (jointly with the academics), a subset of realizable as an undergraduate project is identified and offered to the students. From this point students should apply for one project by presenting their CV and explaining the motivation and reasons for doing such project. Once the selection is done, a first joint meeting between the customer (SAF management), Project Direction (Academic staff) and Project developers (the students) is done. From this point each student has a calendar of meetings (usually every 15 days) between him, the SAF management and the academic associated with the project. If any of the projects needs to collaborate with the work being developed on another project, there is a joint meeting where each one exposes their needs in order to find a joint solution.

Due to the evidence for the need for introducing new control elements and to integrate the different subsystems to help the SAF management staff the collaboration between external entities has emerged. In this context, the SAF entity is the customer (maintenance functions), the ETSE member is the software development group (monitoring the interface, process control), the ETSEIAT member provide us with the project-based learning approach and the EPSEVG member give us the human-centred automation approach [6].

3 ENGINEERING STUDENTS IN THE ROLE OF HUMAN OPERATORS

From the framework described in the preceding section as starting point, the experience is now driven one step forward and a third element is introduced: the external assessment role. The motivation for the introduction of this factor and force it to be developed on a different university (therefore geographically distributed and from a different educational framework/environment) is to create an atmosphere as similar as possible to the one the students will face within their professional life. The total interacting group is therefore constituted of three teams. Each team has a leading academic and a team of students. In addition, each team has associated specific roles corresponding to the professional activity they have to play. The development of such roles is mainly based on scientific and technological skills. These skills will be supervised and evaluated by the corresponding leading academic. In addition, other cooperation and interpersonal skills are to be considered. These skills will be considered by a team constituted by the leading academic members of each team and correspondingly evaluated.

The control engineering students from EPSEVG center have the following roles: software developers (in order to build new supervisory control interfaces), designers (in order to apply ergonomics recommendations to display design), and usability engineers (in order to prepare usability testing and measure efficiency, effectiveness and satisfaction of the SAF human supervisors). This paper presents the application of the Role Playing method in engineering class from the point of view of an industrial automation case study:

a) One engineering student (Msc Automatic Control and Robotics from the Technical University of Catalonia) in the role of control room designer have been developing a new SAF layout in order to identify all the tasks (supervisory control, maintenance, display design and usability testing). This student made a meeting and a questionnaire with the SAF staff in order to obtain information about the physical and mental workload.

b) Some engineering students (from higher school EPSEVG and ETSEIAT) have been using the display design ergonomics guideline (GEDIS guideline) in order to improve the interface quality [7]. In these moments, one student is programming these changes in order to improve the quality of the SAF monitoring interface.

Finally we will explain the feedback of the SAF staff and the effectiveness of this method with the aid of well defined usability metrics and future steps [8].

3.1 Definition of supervisory control task in the SAF project

After a meeting between the SAF manager staff and the external assessment, it is necessary to indicate SAF manager staff a set of important recommendations:

- Train maintenance operators in supervisory control tasks (monitoring and alarm systems)
- Improve the feedback between the manager, the maintenance operators and the software developers
- Re-design the control center layout in order to define a control room (see Fig. 2). It is necessary to establish only a function for each room and translate the meetings inside a meetings room.
- Improve the display design quality. In example, use a ergonomic guideline

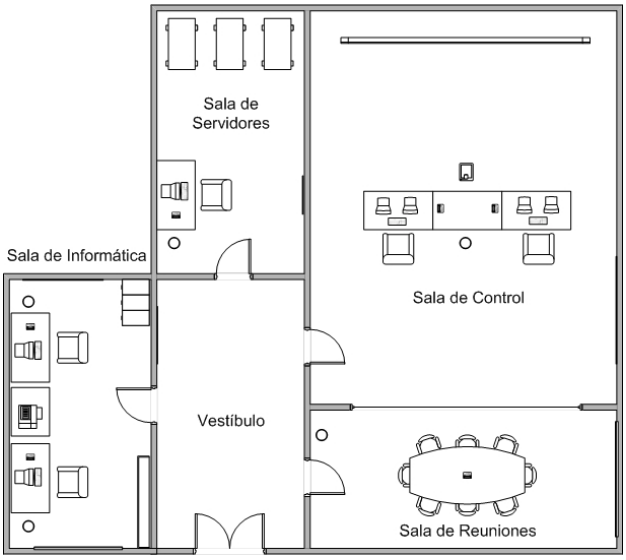

Fig. 2 A possible SAF control center layout with the control room, the hardware location, the meeting location and the software developing location

3.2 SAF display evaluation

The experimental study is the evaluation of SAF interface with the collaboration of control engineering students from Technical University of Catalonia. From Vilanova i la Geltrú city, twenty five students monitoring SAF interface around three weeks. The students define a numeric value for each indicator of the GEDIS guideline and propose interface improvement.

The SAF interface global evaluation with GEDIS guideline is 3,4. The global evaluation is expressed in a scale from 1 to 5, so it is necessary to indicate SAF designer a set of important recommendations:

- revise the relationship between architecture, distribution and navigation indicators
- improve the feedback between interface and human operator in data-entry commands indicator
- improve the location of alarm indicator

With GEDIS guide is possible too to indicate SAF designer a set of important recommendations about graphical screen improvement. For example, the Piscina ACS screen can improve with a set of changes in color and text font indicators. Fig. 3 shows the original Piscina ACS screen and Fig. 4 shows revisited Piscina ACS screen.

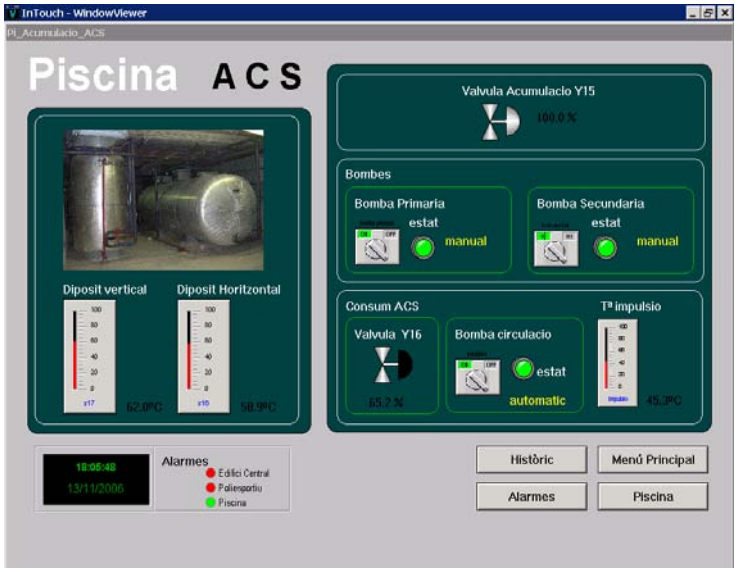

Fig. 3 Original Piscina ACS screen

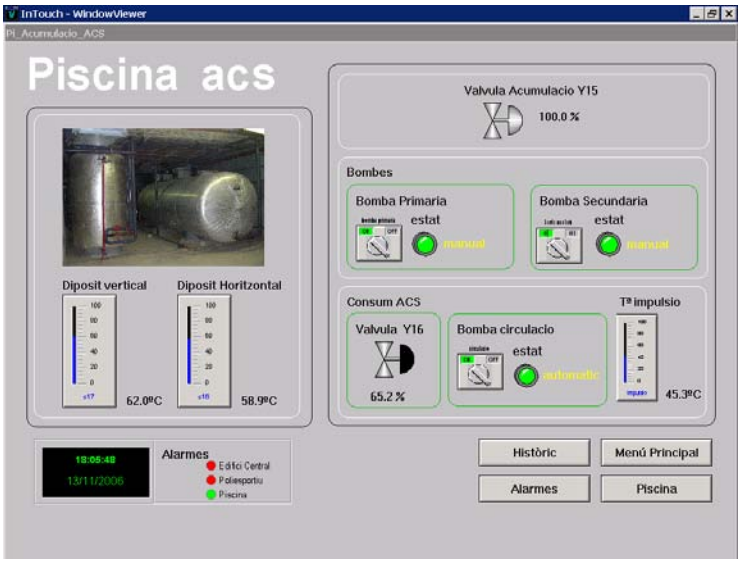

Fig. 4 Piscina ACS revisited with changes in color indicator

4 CONCLUSIONS

This paper has presented an experience that introduces a collaborative framework for undergraduate engineering project development. The idea presented here is based on representing the existing roles present in a professional framework with the additional value of integrating players from different universities and an industrial partner that provides services to the community. It is shown, among other points, how (i) the university itself can provide the customer point's of view, (ii) promote collaborative work between different individual student projects within a global, large, project (iii) provide collaboration among different educational frameworks.

We will continue this work with usability testing in order to measure effectiveness, efficiency and satisfaction metrics over SAF supervisory operators.

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