MULTIMEDIA MATERIAL FOR ACTIVE, COLLABORATIVE AND INTERACTIE LEARNING OF INDUSTRIAL ROBOTICS

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ABSTRACT

This work, the development process of multimedia material and the benefits it provides for active, collaborative and interactive learning of Industrial Robotics is described. Through the development of extremely intuitive learning materials that are simple to use, thanks to their strong multimedia component, it provides excellent learning tools for students of different careers, specializations and levels at UdeSantiago de Chile Therefore, these students are able to know the basics of industrial robotics in general, several methodologies to make their representations and mathematical modeling, their main control systems, in addition to several topics related to this discipline's applicability and future perspectives. That is why, among other resources, the new learning material includes:

- Computational simulation whose general propose is to be used for analysis, validation and practical implementation of control schemes in industrial robots.
- 3D computer animations.
- Varied original experimental videos that include qualitative and practical aspects of control algorithms for industrial robots.
- The possibility to interact dynamically among different students and the teacher, through forums, interactive exercises, surveys, etc.

KEYWORDS

Conceive, Design, Implement, Industrial Robotics, Operate, Standard: 8

1. INTRODUCTION

Robotics is a science, or a branch of technology, that studies the design and construction of machines capable of performing tasks done by human beings or that require the use of intelligence. As a multidisciplinary science (automation, informatics, electronics, mechanics, physics, mathematics, etc.) robotics is continuously subjected to new approaches and treatments. It is a technical discipline that is present in different types of engineering, with different curriculum objectives.

The industrial robot that is known and used in our days did not arise as a consequence or a tendency or desire to produce living beings, but from the need to improve productivity, quality, security and flexibility in manufacturing processes.

Educational robotics arises in the mid-90s as an alternative means of learning based on students' activity, through design and construction of an object. Through its behavior, it is able to support and strengthen specific areas of knowledge. To this end, several

technological tools are available as fixed generic platforms that are characterized by their variable programming and others that are more flexible, such as constructive or modular tools that enable easily changing structural and programming components to adapt quickly to the required conditions. Educational robotics is based on a set of teaching activities that develop cognitive skills in the students through robot construction and programming, built and designed for didactic operation, such as: Understanding, analyzing and reflecting on the scope and use of robotics in fun and interactive way. To this end, pre-mounted systems or entities with simple structures are considered. Three levels may be considered in educational robotics, i.e.: Basic, engineering and advanced; those that depend on the objectives to be met, i.e.: Design and/or user, therefore, educational robots may be used by students ranging from primary education to post graduate levels, in different environments, i.e.: Teaching, research, socialization, etc.

International experiences in teaching robotics in the classroom demonstrate that the insertion of educational robotics in teaching practices in university research centers has begun from "robotics literacy." This has to do with the knowledge of basic concepts, as well as the most specific ones related to mathematical representation of machines, computer simulation in equipment, robot archetypes or basic models for industrial assembly, etc. Therefore, this work presents the development of tools for active, collaborative and interactive learning of industrial robotics, which enables personalized and intuitive transition through varied levels of learning in this area of robotics.

2. INSTITUTIONAL EDUCATION MODEL

The Institutional Educational Model of Universidad de Santiago de Chile considers the students' formative process that which gives meaning and purpose to our university work.

As seen in the diagram of Figure 1, considering the student as the center of the formative process, teaching has a primary role, understanding that the construction of knowledge is carried out by a series of mechanisms that consider teacher mediation and students' individual work.

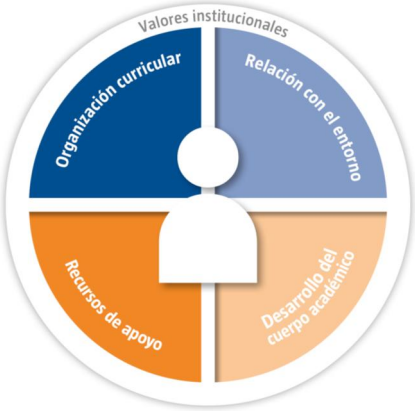

Figure 1. Diagram of the Institutional Education Model

According to the institutional seal, those graduating from Universidad de Santiago de Chile must:

- Work as a team toward a common objective. This implies assuming an active role in organization and distribution of activities, and taking responsibility for task development of their competence and demonstrating a respectful attitude toward the team members.

- Exercise leadership within the performance environment, being capable of coordinating, directing and monitoring the work of others in a way that is proactive, projective and strategic.
- Autonomously learn the knowledge or skills that are necessary to meet the challenges that are presented in performing their functions, seeking permanent improvement in professional or academic performance.
- Develop a permanent focus on innovation and entrepreneurship in new challenges in the exercise of their professional or academic role, seeking constant improvement of their reality.
- Take on an ethic stance in performing and making decisions in professional, academic and citizenship areas.
- Act based on a principle of social responsibility and citizenship awareness in the exercise of any professional or academic activity.
- Develop full knowledge of their mother language and encourage the knowledge of other languages and general culture of where they are inserted.
- Demonstrate adaptability to conditions and characteristics of different professional or academic scenarios which they may face.

3. INDUSTRIAL ROBOTICS IN THE CLASSROOM

Teaching and learning industrial robotics in the classroom, thanks to the support of the developed multi-media material, allows us to follow the path of pedagogical renewal. Like any change, this requires effort and dedication, with the ultimate purpose of improving the quality of education in local and national settings, because its purpose is to provide knowledge and develop skills needed for the study of this discipline, facilitating reading comprehension and knowledge understanding. This has an important impact on professional, academic and labor, and in students' development, because our personal experience with students in the area of robotics at UdeSantiago and universities abroad have led us to conclude that very early on, these students can behave like scientists and young engineers if they are provided with adequate tools and are allowed to apply basic principles of scientific research such as: Observation, testing, comparing and contrasting phenomena related to robotics, predict functioning and registering individual and collaborative experiences. For the reasons above, this paper presents an improvement in institutional capacity to generate effective learning in graduate and undergraduate students, in the area of industrial robotics, considering all its cross-cutting and multidisciplinary character.

4. TEACHING TOOLS DEVELOPED FOR THE CLASSROOM

Developing tools to facilitate “literacy in industrial robotics” included the design and implementation of new teaching material for active, collaborative and interactive learning in the area of industrial robotics, it present applications and future perspectives. The following was therefore proposed:

- New study textbook to deliver knowledge and tools in a simple and intuitive manner.
- Design and implementation of multimedia resources with original content using: Hiperlinks, 3D animations, etc. to enhance comprehension and understanding the contents of the new textbook.
- Acquire theoretical and practical tools that enable students to distinguish among situations where industrial robotics is applied, such as: Identifying and relating diverse types of

industrial robots, available on the global marker, to use them efficiently in specific environments.

- Implement the newly created study material and newly designed multimedia tools, in a multimedia platform.

5. DEVELOPMENT STAGES OF THE TEACHING TOOLS

Stage 1: Creation of a new study textbook in the area of industrial robotics, which includes the following topics:

- Description of industrial robots.
- Kinematics of manipulators
- Dynamics of manipulators
- Path planning and generation
- Control of industrial robots.

Stage 2: Design of: Hyperlinks, image gallery, footnotes, interactive images, 3D animations and other multidimensional links that enhance understanding and comprehension of the contents of the new study textbook.

Stage 3: From the new study textbook created in Stage 1 and all the multimedia material developed in Stage 2, in this stage, the process required to implement these contribution took place, uploading its contents to a multimedia platform.

Stage 4: Tests and validations of the results of the implementations.

6. IMPLEMENTATIONS OF THE TEACHING TOOLS

According to the proposed stages in developing the teaching tools in the above section, a summary of these implementations is presented:

After the creation of a new study textbook that included the topics of the industrial robotics area described in “Stage 1” a multimedia work platform called “MOODLE 2.0" (Modular Object-Oriented Dynamic Learning Environment), a virtual educational environment web application and that helps educators create online learning communities to transfer knowledge of robotics. The reason for choosing this multimedia platform is that its design is based on constructivist teaching, where knowledge is constructed in the mind of the student, instead of being transmitted without changes from books or through teaching, and in collaborative learning. Teachers using this multimedia platform create a student-centered environment that helps students build knowledge based on their own skills - but considering the contributions delivered by the teacher- instead of the teacher simply publishing and transmitting the information he or she considers the students must know. Another advantage of using this multimedia platform is that it allows for group interaction and, at the same time, it allows for private conversations among the students.

This multimedia tool may be accessed at the following web address: http://www.udesantiagovirtual.cl/moodle2/login/index.php, where students registered in this course must enter using their own “user name” and “password.” After entering, the student will see the following screen:

Figure 2. "Welcome" Screen

As seen in Figure 2, the student may choose either Links of academic interests, wikis on robotics (information relevant to the diversity of robotics, including history, technology, etc.), chapters with course contents, etc.

Once the students select to visit the course contents, if they choose the first chapter, or any other chapter, the screen shown in Figure 3 will appear, where information may be read directly from the screen or it may be downloaded in .pdf format to be studied later. Each chapter has hyperlinks for further in-depth study of each stage; however, this will depend on the emphasis that is desired for each topic within the vast range of knowledge considered for this tool for "literacy in industrial robotics."

Figure 3. "General Introduction and Basic Concepts" Screen

Figure 4 shows the hyperlinks related to other areas of robotics, enabling students to achieve learning beyond industrial robotics itself, according to their own autonomy and personal interest in this science.

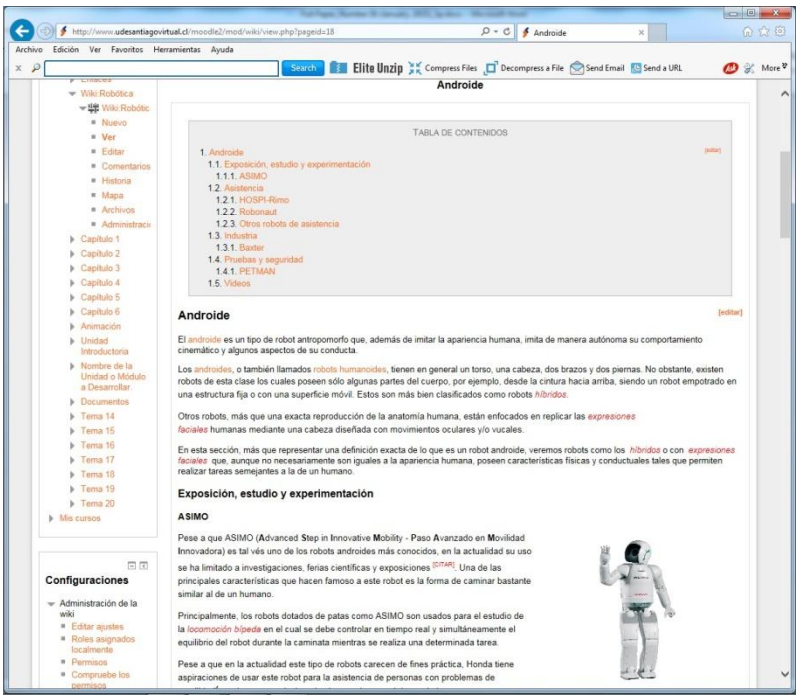

Figure 4. Screen with hyperlinks toward types of android robots

Periodical maintenance of this learning tool is carried out, considering updates and improvements according to scientific progress in robotics and suggestions provided by the users themselves (students).

7. RESULTS OBTAINED

Design and implementation of new interactive study material that stimulates active, collaborative and interactive autonomous learning, mainly in the area of industrial robotics, present applications and future perspectives, done simply and intuitively and in a non-encrypted manner. This possibility of interacting dynamically among diverse students and teachers is carried out through forums, interactive exercises, surveys, etc. This learning has an important impact on the formative process of students thanks to the acquisition of theoretical and practical tools that enable them to distinguish among situations in which industrial robotics participate within the national and international reality.

8. EXPECTED IMPACTS

- Consolidation of a teaching-learning process related to the integral training approach of graduate and undergraduate students, thanks to the access of the latter to simulators and computer animations of industrial robots, etc., that allow them to safely interact with the world of robotics and all its potential.
- Increase student retention rates, thanks to the active, collaborative and interactive process that is more fun and motivational than listening to teacher lectures.
- Graduates with improved labor insertion.

- Effectively contribute with a set of attributes that must constitute a basic part of graduates' profile, in order for them to distinctly contribute to the country's development (Institutional Seal).
- Contribute to continuous strengthening of the institutional activities of Universidad de Santiago de Chile.

9. CONCLUSIONS

Teaching and learning are central aspects that must be valued according to new cultural scenarios, which demands continuous renovation of teaching practices, considering diversity and inclusion of the student body, arising from the development of their academic talent.

Considering the student as the center of the formative process, teaching has a primary role, understanding that the construction of knowledge is carried out by a series of mechanisms that consider teacher mediation and students' individual work.

Teaching robotics in the classroom, thanks to the support of the developed multi-media material allows us to follow the path of pedagogical renewal. Like any change, this requires effort and dedication, with the ultimate purpose of improving the quality of education in local and national settings, because its purpose is to provide knowledge and develop skills needed for the study of this discipline, facilitating reading comprehension and knowledge understanding. This has an important impact on professional, academic and labor, and in students' development.

In general, students can behave like scientists and young engineers early on, if they are provided with adequate tools and are allowed to apply basic principles of scientific research such as: observation, testing, comparing and contrasting phenomena related to robotics, predict functioning and registering individual and collaborative experiences. For the reasons above, this paper presents an improvement in institutional capacity to generate effective learning in graduate and undergraduate students, in the area of industrial robotics, considering all its cross-cutting and multidisciplinary character.

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