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An Open eLearning Platform for Robotics Training (OpenPLeRobot Project)

George Koutras*, Aggeliki Psycharaki, Themistoklis Koutsouras, Christos Koutras

Open IT Information Technology Solutions, Komotini, Greece

Email address:

koutras@openit.gr (G. Koutras), psycharaki@openit.gr (A. Psycharaki), ckoutras@openit.gr (C. Koutras), kutsuras@openit.gr (T. Koutsouras)

*Corresponding author

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Abstract: In Greece, educational robotics does not have the impact observed in other countries, mainly because of the limited number of structures that offer educational robotics courses, the cost of participation, the cost of robotic packages and the lack of time of young students combined with the inability to move independently. OpenPLeRobot project promotes development of innovative product of eLearning open platform for Robotics Training, with experimental learning procedures and promotes the idea of an integrated robotics toolbox of education and training, based upon innovative ICT tools, that simulates robotics applications in virtual reality environment, supported with robotics training equipment and ICT toolkits. OpenPLeRobot project is designed to support communication of trainers and trainees of robotics, through synchronous and asynchronous e- learning educational environment, in pre - school and school children and performs as a prototype robotics laboratory that stimulates creative robotics constructions and motivates computational logic in education. As a result this project has positive results at all levels of the educational process, and providing skills (teaching becomes more effective), motivation (the conscious and unconscious factors are enhanced), readiness (helps to build an adequate background of experiences), experience (enhances experience), adaptation (improves the ability of the individual to live harmoniously) and health (contributes to the proper normal physical health, but also to his mental health).

Keywords: eLearning, Preschool Learning, Robot Programming, Robot Training

1. Introduction

Educational robotics is the application of the science of robotics to education. It is of course one of the most important fields of computing today with its main tool the programmable robot (physical or virtual), capable of performing specific actions in an environment. The robot can be used inside and outside the school to develop programming knowledge, problem-solving ability, collaboration between students while contributing to the understanding and assimilation of technical knowledge. In Greece, educational robotics does not have the impact observed in other countries, although there is relative interest from young people and their families as well as from public and private educational institutions [8-11]. The use of robotics in our country is limited to few Universities' curriculums, while in primary and secondary education it exists only in private education and sporadically in public schools under the responsibility of individual teachers and always beyond the official schedule. The main reasons for this lag, especially in relation to young people, are:

1) the limited number of structures that offer educational robotics courses;
2) the cost of participation;
3) the cost of robotic packages;
4) the lack of time of young students combined with the inability to move independently.

In this paper OpenPLeRobot project is described, which aims to develop an innovative distance learning robotics product with exceptional features. In particular, the OpenPLeRobot project aims to create a complete

robotics training package based on new software tools capable of simulating robotics applications in a virtual environment in combination with a portable robotic equipment unit so that the learner transforms the theoretical knowledge of the digital environment into a real experience [12-15].

The OpenPLeRobot project is designed to help educators and learners communicate online, both within and outside a workgroup, as it provides teacher-student communication through a digital robotics learning environment. The OpenPLeRobot project focuses on preschool and elementary school children (5-7 years old) with the primary goal of exploring the usability of a robotic platform and a robot, including robotic construction and the programming environment.

2. Project Implementation Methodology

2.1. Implementation Approach

The approach of the OpenPLeRobot project is based on the know-how of the team members, mainly from its involvement in numerous similar projects. The know-how is reflected in a series of methodologies, which are subsets of an integrated methodological framework and are applied according to the specific needs of each project. It is worth mentioning that for the needs of each project the project team modifies / configures the methodologies and tools so that they adequately meet its requirements.

The steps for implementing the OpenPLeRobot project are shown in Figure 1 and correspond directly to the corresponding work sections, which are described in detail below.

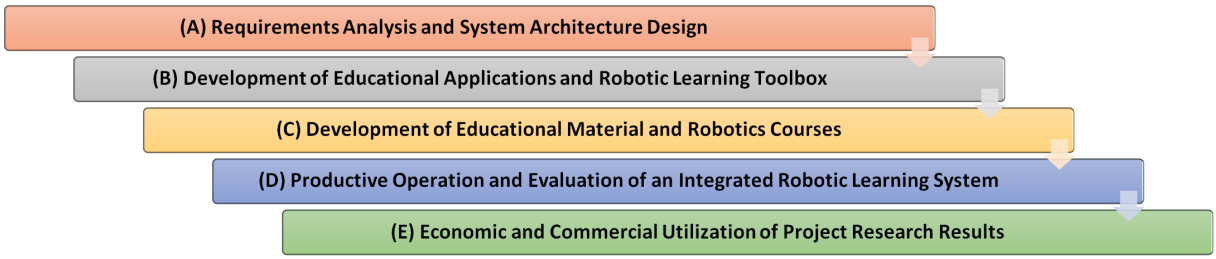

Figure 1. *Steps for implementing the OpenPLeRobot project.*

2.2. Steps of Implementation

Characteristics of the methodological steps that will be used are critical requirements which must be met in each case, making the given methodology suitable for the context, environment and objectives of each project.

The OpenPLeRobot project will include the following project implementation methodologies, due to its interdisciplinarity and complexity:

1) Modern Educational Approaches.
2) Methodology for Implementation of Information Systems / Internet Applications.
3) Project Management Methodology.
4) Quality Management & Assurance Methodology.

3. OpenPleRobot Project Presentation

3.1. Requirements Analysis and System Architecture Design

The purpose of this section is to analyze the requirements of users in relation to the system under development and to design a complete set of mock-ups (UI Mock-ups) for the characteristics of the system interface [1].

The aim of this section is to produce the final design solution that will be in line with the functional characteristics of the system at the level of architectural solution but also the needs and requirements of users, based on usage scenarios and design approach.

3.1.1. Requirements Analysis and Usage Scenarios

This activity focuses on the needs and expectations of users in relation to the system under development. Based on the research that will be carried out with the participation of end users (trainees and trainers), the appearance, user experience and the expected functionality of the Open Robotics Training Platform will be determined.

Key issues with collecting receivables include:

1) supporting the activities of user groups through the system.
2) the creation of services that have been designed with their participation but also by interdisciplinary teams and
3) ensuring the availability of the technologies necessary for the execution of the project.

Requirements will be collected through interviews with end users (trainers and trainees). Next, usage scenarios will be created which will be described as sequences of events. Script development is an activity that involves users, usability experts and software engineers. The scenarios should be understandable to the end users and correspond to their idea for the application, while at the same time being sufficiently technical so that the software engineers can understand the logic of the system. Finally, all the scripts will be recorded in UML.

3.1.2. System Design and Evaluation

This activity will design the system architecture based on user requirements, usage scenarios and design to be performed in previous activity. The result of this activity will be the overall system architecture, its breakdown into functional modules and components, with detailed specifications for each of them, including operational and operational requirements, as well as details on software interactions and interfaces [2].

3.1.3. System Architecture

The architecture should address diversity in equipment (hardware and software) and allow for future changes, updates and upgrades. This activity will identify the general methodologies, technologies and standards that will form the basis for the technical and scientific work to be performed during the development of the system and will be based on the results from the previous activities.

3.2. Development of Educational Applications and Robotic Learning Toolbox

The purpose of this section is the development of the Open Robotics Training Platform, which will be the background for hosting all operating subsystems and training materials. The Open Robotics Training Platform will incorporate modern learning and design principles and will be functionally adapted to the needs and requirements of end users (trainees and trainers).

3.2.1. Development of a Modern and Asynchronous Robotic Learning Training Platform

Learning Management Systems (LMS) environments can be powerful tools in education, especially when combined with learning principles such as the principle of interactivity and adaptability [3]. In the case of robotic education, the available eLearning environments protect significant improvements in order to offer effective solutions to the end user. Developing an effective eLearning environment requires a full understanding of the features offered by current technologies and the definition of a set of well-documented educational goals.

OpenPLeRobot project develops the Open Robotics Training Platform, using an existing LMS as a basis, in order to take advantage of its provided functions, such as course creation, activity (quiz), user tracking and user tracking. various tools of cooperation and communication. In addition, new features will be developed on the platform, aiming to support the educational needs of users and to cover the full range of modern and asynchronous educational process for learning robotics.

The content of the platform will be represented through a friendly and easy-to-use navigation interface. The learning material will therefore be presented to the end user through an educationally documented flow. The development and posting of high-quality digital material (animations, multimedia content, HTML pages enriched with graphics, etc.) will be graded according to the level, features and knowledge of the users.

The Open Robotics Training Platform aims at the delivery of quality and integrated modules of educational material, which will be available to students and schools. The functionality of the platform, however, does not stop at the simple delivery of material, but continues through careful, pedagogically correct and scientifically documented ways, using new technologies, interactive tools, multimedia applications, collaborative tools and many other functions, taking full advantage of offered by educational technologies.

3.2.2. Electronic Knowledge Repository

As part of the OpenPLeRobot project, the creation of an electronic knowledge repository in which the learning objects of the Open Robotics Training Platform will be stored will enhance its overall value. The implementation of the repository will result in the support of the interoperability of the platform and the achievement of the autonomy of the learning objects that have been created in the platform, through their description with appropriate metadata.

3.2.3. Development of Educational Applications

The Open Robotics Training Platform supports the integration of educational applications. The type of training applications will result from recording the requirements of the end users. Experience shows that educational applications, for end users in these specific age groups, it is good to be closer to games, with features based on childhood experiences, such as images of well-known robots or figures of child heroes. The educational applications will incorporate interactivity features with motion, images, videos and sounds while it will use easily recognizable educational tools such as multiple-choice questions, matching questions, crossword puzzles, cryptocurrencies, gap filling questions etc.

3.2.4. Development of a Robotic Learning Toolbox

It includes the development of a robotic matrix for the creation of robotic packages (per age group), in the form of a suitcase, with appropriate equipment for the construction of simple robotic structures which will provide the possibility of developing many different structures but also expandable sensor addition and subtraction. These packages will include microprocessors, sensors, motors that with the help of building material can compose various robotic constructions.

3.3. Development of Educational Material and Robotics Courses

This activity will develop the educational material and robotics courses, which will be integrated in the Open Robotics Training Platform [4].

3.3.1. Educational Scenarios in Robotic Learning for Two Age Groups

Formulating educational scenarios includes identifying learning objectives and teaching model, developing scenarios, system of rules, motivation and intervention strategies. The construction of the scenarios will be based on a methodology of constructionism, so that the learners can build knowledge more effectively and are actively involved in the design and construction (manual and digital) of real objects that make sense to them. In this context, two educational scenarios will be structured for preschool and primary school children, while the whole mechanism of writing educational scenarios will be developed as a process, so that in the future educational scenarios for other age groups can be developed in an easier and automated way.

3.3.2. Multimedia Material Supporting Educational Applications

The development team has members who are specialists in user interface and graphic design, who will produce the creative material required for the educational applications and the educational material of the educational robotics courses. The recognition of the design requirements will be based on the needs that will be reflected in the training scenarios but also the general requirements, as they will be produced. The material will be imprinted in graphic representations (Mock Up Story Boards), where through repetitive approaches, but also through the continuous communication with the end users, it will be finalized in final imprints of characters, graphics, virtual approaches and other design templates.

3.3.3. Development and Production of Robotic Learning Training Material

Project team based on its many years of experience in robotic learning training processes, will develop the training material. The educational material will consist of text files, audio files, video files, animation files and dynamic material as well as activities and questions of different types, which will be interactive and will consist of games and quiz of different types (drag and drop, multiple selection, filling in blanks, right or wrong, etc.). Also, functions and resources such as Notebook, Glossary of Concepts, Library of good practices, help that will enhance the quality of the educational process will be supported for each user of the platform.

3.4. Productive Operation and Evaluation of an Integrated Robotic Learning System

The aim of this module is to integrate all technologies and theoretical background into a unified system, which will be evaluated repeatedly, in order to ensure its productive operation and optimize its performance.

3.4.1. Pilot Application of Productive Operation

As part of the pilot application of the open Robotics training platform OpenPLeRobot, all subsystems will be installed and interconnected in order to be put into experimental operation. In addition, once the system is properly functioning, extensive test operations will be performed, with the help of students and teachers [6].

3.4.2. Development of a Toolbox for Interoperability with Other Robotic Learning Systems

In this activity will be developed all the tools and computer interfaces - Application Programming Interfaces (APIs) that are necessary so that in the future the Open Robotics Training Platform can be functionally and informatively connected to any robotics training system [7]. The interfaces will be developed using open source to ensure high interoperability and the easiest possible integration of the system and its information into future external systems. In this way the viability of the system increases exponentially and ensures an excellent market response from manufacturers of complementary robotic training systems.

4. Conclusions

The main result of the OpenPLeRobot project is the development of a product that will contribute to the integration of robotics in the educational process inside and especially outside the school environment (home, hotels, creative spaces, playgrounds, etc.). The product produced by educational robotics for children helps to develop students' superior skills and abilities such as problem solving, exploration, teamwork, decision making, introduction to programming, engineering and construction design and all this in an active, creative environment.

Robotics in the learning environment also helps students develop a deeper understanding of how various physical objects work and work, how they can control them, and finally how they can make the connection between the abstract and the concrete.

Through the product a wide range of experiments that cover many cognitive objects can be performed with the help of the Open Robotics Training Platform and robotic constructions while at the same time children can be introduced to programming. The interaction, collaboration and expression of young learners in solving open-ended problems from the real world can achieve a fuller understanding of the subject. Robotic education through the involvement of children in the analysis, design and implementation of robotic structures facilitates the development of an environment of authentic activities and experiences.

In this context, OpenPLeRobot has positive results at all levels of the educational process, and providing:

1) Skills: Teaching becomes more effective by cultivating and promoting students' general (e.g. intelligence) and special skills (e.g. movement, expression).
2) Motivation: The conscious and unconscious factors that stimulate, maintain, regulate, support and direct the individual's behavior are enhanced, enhancing the motivation of human behavior.
3) Readiness: Helps to build an adequate background of experiences that are considered necessary for the acquisition of new qualifications.
4) Experience: Enhances experience as a dynamic set of impressions, perceptions, perceptions, emotions and skills.
5) Adaptation: Improves the ability of the individual to live harmoniously with his environment while maintaining his personal integrity intact.
6) Health: Contributes to the proper normal functioning of the external and internal organs of a person's body through exercise, but also to his mental health that comes mainly from adaptation, meeting his mental needs and avoiding conflicts.

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