Annals of Robotic Surgery

Review Article

Published: 15 Mar, 2019

Application of System Analysis for Teaching Robotics

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Abstract

After presenting of the need for using robots in medicine, we present an application of system analysis for the design of a tutorial for teaching robotics. The experience is situated in training students in view to get a university degree in engineering. The essential of this methodological approach is to specify the composition of the various teaching modules in robotics to be accessible to the students by a system modeling method and to develop a digital support that can be exploited in distance learning.

Keywords: Tutorial; Teaching robotics; System analysis

Introduction

Generally, a tutorial is classic software teaching assisted by computer to put in a situation, more or less interactive, a student and a problem to answer [1]. This software is specialist and deal with detailed content (robotics, industrial computers, technology...). This software is considered environments specializing in specific topics [2].

The design of this application is based on interactive dialogue, and learning usually involves the center memorizing and training sequences of procedures linked with certain concepts. They are now distributed quite generally in packages to cover an exacting domain connected with a work environment that also includes dedicated tools (word processing, database...) [3].

The tutorial is a practical tool, not only for the authors by sensitizing them to the challenges of learned computer publishing and giving them the tools to develop their mastery of traditional word processing tools, but also for the services and administrative structures that will be gradually more solicited to circulate and promote scientific production by offering models and tools for implementing computer broadcasting projects [4].

The aim of the present study is to demonstrate interests of a tutorial for teaching robotics. The next section briefly presents the concepts of robotics and the application of robots in medicine. In Section 3, after presenting a system analysis methodology based for the specification of a tutorial for robotics, this approach is applied to the analysis this project. The last section presents a discussion about impacts of this tutorial on teaching.

Presentation of Robotics

Robotics is the branch of artificial intelligence concerned with the study of automatic system capable of direct interaction with the physical world.

With growing precision, the robotics industry is more and more place in modern surgery and medicine in General. The examples are: assistance during surgeries asking tool of high accuracy constant search of new robotic applications to help development in the biomedical field improved care for patients [5]. Figure 1 shows an example of a robot in medicine [6].

Medical laboratories also require robots to perform repetitive and specific tasks. Ability to analyze several samples or samples of test and measurement systems automated. Small mobile units capable of transporting samples between Labs, minimizing multiple travels of technicians [7].

Table 1 shows human-robot manipulator arm analogy.

There are two types of robots [8]:

- Manipulator robot intended for performing a task, sufficiently precise, is difficult to find on the market unless specially designed or programmed. The majority of the existing robots are called question in their sites and to answer to the requirements of their users.
- The mobile robot is interested in the industrial field, and even in the life of all the

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Received Date: *20 Feb 2019*
Accepted Date: *12 Mar 2019*
Published Date: *15 Mar 2019*

Citation:
Lakhoua MN. Application of System Analysis for Teaching Robotics. Ann Robot Surg. 2019; 1(1): 1002.

Table 1: Human-robot manipulator arm analogy.

Arm and brain	Function	Equivalent on a robot
Blood vessels	Arrival of blood loaded with energetic elements	Arrival of the energy source
Bone	Skeleton (arm+hand)	Polyarticulated mechanical system (arm+wrist)
Muscles	Motor function	Actuators
Tendons	Muscle-bone connection	Transmission
Proprioceptive sensors	Control of the level of contraction of the muscles	Intern sensors
Exteroceptive sensors	Environmental information	Externe sensors
Spinal cord and brain	Command	Calculator or control system

days; in fact, their use can be heard to perform tasks of the hostile environments, tasks managers, means of travel for people with disabilities and ways of common transport etc.

To identify the components of a robot, we presented the following list [9,10]:

- Mechanical aspect: it is the skeleton of the robot which formed by five parties: chassis, structure, (the wheels and legs) locomotion engine and torque.
- Electronics: being a very sensitive part of the robot, it should be protected. All links between the cards, sensors, motors and power are all sensitive points. One of the ideas is to group the maximum of deal on a single map or consolidate the maximum of function on a single component.
- Energy: it is to define self-government skipped for normal operation and secondarily from the capacity on several independent sources. Energy is composed by regulation, batteries, chargers, and securities.
- Actuators: are grouped under the term of actuators all that transforms electronic energy into mechanical energy.
- Motors and relays are therefore considered to be conventional actuators.
- Transistors: it is the main component of an interface for engine is the transistor.
- Integrated circuits: these components are very practical. They integrate all that is necessary to achieve H-bridge. The control part is directly compatible with a microprocessor.
- Chopper: it uses the principle of modulation bandwidth impulses applied to the engine. The speed control by pulse width modulation is much better and more efficient at low speeds.
- Motors continuous: they are most of the time associated with gear-motors that reduce the speed of the motor shaft to reasonable values for the robot. We can control the speed by varying the voltage or by using a command in PWM. The duty cycle of the signal will change the torque of the engine speed.
- Stepper motors: when they provide traction, they allow estimating the position of the robot with a good precision in counting the number of impulses sent on each engine. In order to relieve the CPU, these engines are often associated with motor control cards to generate signals and create movement through simple commands.
- Servo motors: they are found in many small robots. They are used in the world of the model to make small circular movements.
- Control part: she is physically materialized by the

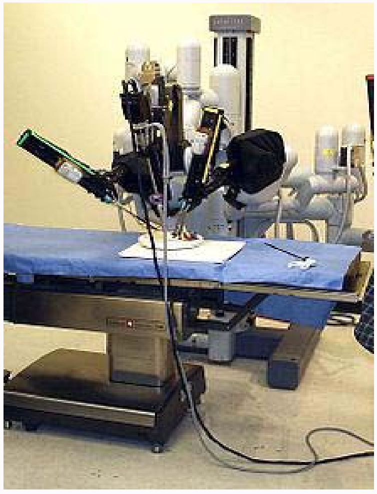

Figure 1: Using a robot in medicine.

microcontroller that has in-house program will perform based on the application for which it was designed. This operating mode is particularly suited to the so-called "embedded" applications where humans cannot intervene directly and or the desired machine behavior is defined in advance.

Specification of a Tutorial for Teaching Robotics

Nowadays, the construction of a tutorial is considered to be original a solution to a problem. It must follow certain pre-defined and necessary steps which are:

- The choice of the subject and the language programming that is the preliminary point.
- The definition of the operational objectives of the tutorial.
- The planning of the tutorial.
- The programming and testing of the tutorial.

A reflection on these points leads us to adopt a methodology which is to realize a tutorial for teaching robotics on a structured analysis. This is why it is essential to identify the impact of the use of courseware in the teaching robotics [11-13].

In fact, the structured analysis methodology was used in the analysis of medical systems particularly medical equipments in a hospital system in order to get perceptions and correct understandings of the internal working of these equipments [14-16].

The objective of this planning methodology is to describe the diverse activities of the project. This needs identifying the objectives.

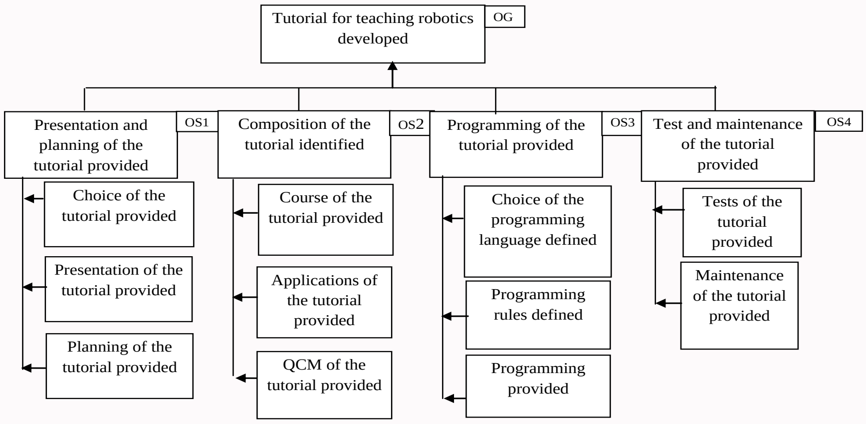

Figure 2: Tree of the objectives of the tutorials for teaching robotics.

It is in this step to organize an integrated and predetermined configuration or to organize and change according to a plan the tutorial [17,18].

This analysis allows us to identify four objectives.

- OS1: Presentation and planning of a tutorial for teaching robotics.
- OS2: Composition of a tutorial for teaching robotics.
- OS3: Programming of a tutorial for teaching robotics.
- OS4: Test and maintenance of a tutorial for teaching robotics.

We present on Figure 2 the development of the objectives tree of a tutorial for teaching robotics.

The tutorial corresponds to methods of transferring information and may be used as a component of a learning process. More interactive and detailed than a book or a lecture tutorial seek to teach by example and provide the information to complete a definite task.

Tutorials usually have the next characteristics:

- A presentation of the view generally explaining and showing the user interface.
- A demonstration of a process, using examples to show how a workflow or process is completed; often broken up into discrete modules or sections.
- Some method of review that reinforces or tests understanding of the content in the related module or section.
- A transition to additional modules or sections that builds on the instructions already provided.
- This project of designing a tutorial for teaching robotics also made it possible to form a web platform developed for teaching robotics using HTML platform.

Conclusion

By definition, Robotics is a multidisciplinary science requiring the collaboration and the participation of several fields of expertise engineering: mechanical engineering; electrical engineering; computer science; physics; mathematics. On find Robotics everywhere. It simplifies life in several ways and contributes to the technological advancement. However, we are very far away to see robots with the same intelligent capacity as human.

This contribution aims to share teaching experience in higher education for teaching robotics. Methods were applied to improve teaching through active tutorial. The original approach to this tutorial is the specification of the content and that by adopting a system analysis method.

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