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Presentation

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In Number 1st presented an article Design of a robotic robot for the Universidad Tecnológica del Sur del Estado de Morelos *by FIGUEROA-ÁVILA, Dafna, GRAFE, Hermann and VELÁZQUEZ-SANTANA, Eugenio César, in the next Section an article* Gripping robotic system composed by a pair of robots petit *by FERNÁNDEZ-RAMÍREZ, Arnoldo, CUAN-DURÓN, Enrique, GARCÍA-ANDRADE, Roxana and URQUIZO-BARRAZA, Elisa with adscription in the Instituto Tecnológico de Nuevo León, Instituto Tecnológico de la Laguna, in the next Section an article:* Mathematical modeling: characterization of a proposal for the teaching and learning of multiplication and division *by MARTÍNEZ-SOTO, Jorge Luis, HERNÁNDEZ-GUTIÉRREZ, Francisco Javier, LIZARDE-FLORES, Eugenio and ZÚÑIGA-ZUMARÁN, José Luis with adscription in the Rural normal school "Gral. Matías Ramos Santos", in the next Section an article* Locomotion planning using OBs for a Robot Nao *by* MONTECILLO-PUENTE, Francisco Javier, SAMANO-ABONCE, Obed Noé and LÓPEZ-QUIJAS, Daniel *with adscription in the Instituto Tecnológico Superior de Salvatierra.*

Content

Article **ECORFAN Journal**
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Design of a robotic robot for the Universidad Tecnológica del Sur del Estado de Morelos

FIGUEROA-ÁVILA, Dafna*†, GRAFE, Hermann and VELÁZQUEZ-SANTANA, Eugenio César.

Received July 18, 2016; Accepted October 20, 2016

Abstract

This paper begins the research of educational robotics and the Internet of things, which is opening in the Career of Information Technologies and Communication of the Universidad Tecnológica del Sur del Estado de Morelos, which aims to tell with contributions of scientific inquiry in this field. This article proposes the design of a robot kit Vex Robotics®, programmed with software RobotC®. This robot will collect road and allow crops to be carried out at this university, through Career Sustainable and Protected Agriculture.

Robotics, educational, Internet, Technologies

Citation: FIGUEROA-ÁVILA, Dafna, GRAFE, Hermann and VELÁZQUEZ-SANTANA, Eugenio César. Design of a robotic robot for the Universidad Tecnológica del Sur del Estado de Morelos. ECORFAN Journal-Democratic Republic of Congo 2016, 2-3: 1-9

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Introdution

The present research consists of designing a didactic robot that can be programmed by the students of the Information Technology and Communication Career of the Technological University of the State of Morelos (UTSEM), through a Robotics workshop within the institution, can put into practice their theoretical bases. The kits they manage are from Vex Robotics®, which is a very interesting platform for learning in the areas of science, technology, engineering and mathematics, where students can research using robotics technology.

Even after scientific and engineering principles, a VEX robotics project promotes teamwork, leadership, and problem-solving skills. It also allows teachers to easily customize projects to meet the students' skill level.

VEX is one of the platforms that is expanding more rapidly. It is intended for use from the secondary level to the higher level, although it is also an optimal platform for fans of robotics and competitions. (VEX, 2016)

The software used to manage robots is RobotC®, which is a programming language for the development of educational robotics, which is complemented by VEX kits. ROBOTC is a C-based programming language, with an easy-to-use development environment. (RobotC, 2016)

The article is organized as follows: in the beginning the introduction is placed, then the antecedents, then the methodology to be developed is presented, following the development, the results, the acknowledgments and, finally, the conclusions.

Background

The educational model of the Technological Universities is created as an alternative of vocational training for the student to join the productive sector in the short term. The above, due to the fact that in only 2 years of preparation, he received a professional title of Higher Technical University, having the option to carry out the continuity of studies for a year and eight more months to conclude with Bachelor's and / or Engineering degree. (UTSEM, 2016)

UTSEM is located in the municipality of Puente de Ixtla, Morelos, which began its academic activities on September 06, 2012 with the courses in Sustainable and Protected Agriculture; International Business Operations: International Business Area; Information and Communication Technologies: Multimedia Area and Electronic Commerce; And Tourism: Development of Alternative Products. (FIGUEROA-ÁVILA, 2015)

For the UTSEM, the integral education of the students is of paramount importance, where it is sought to combine the academic formation of the student with extracurricular activities, being the main objective to provide the bases in art and culture to the student so that he achieves an optimum development and exploits his Creativity in the actions that are carried out. In these workshops not only develops the theoretical part, also seeks to bring the student in practice. (UTSEM, 2016)

Among the several workshops that are taught, is the Robotics, which is made up of 25 students of the career of Information Technology.

Methodology

In this research was handled a qualitative process of Sampieri, this approach is based on important research areas or topics. However, instead of clarity about research questions and hypotheses prior to data collection and analysis (as in most quantitative studies), qualitative studies can develop questions and hypotheses before, during, or after of data collection and analysis. Often, these activities serve first to discover what the most important research questions are, and then to refine and answer them.

The inquiry is moving dynamically in both directions: between the facts and their interpretation, and it is a rather "circular" process and not always the sequence is the same, varies according to each particular study. (Sampieri, 2010)

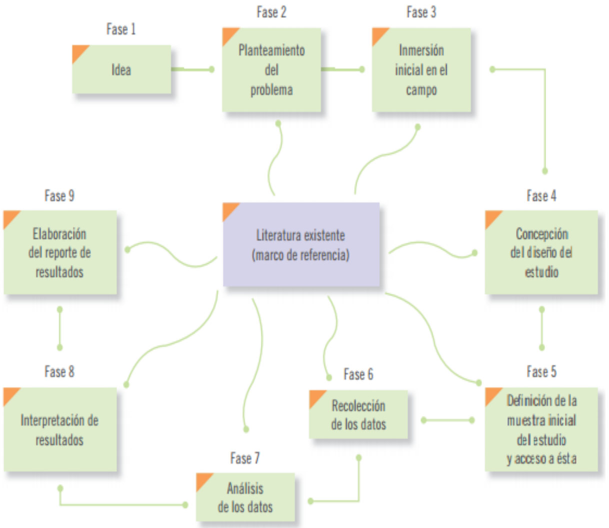

Figure 1 Conceptual map of the use of the methodology with qualitative approach Sampieri.

The present work requires that nine phases are carried out for the design and development process of the same.

1. Idea.- At this stage, the research and exploration of the techniques, tools and methodologies that will serve as support to develop the design of a harvesting robot is carried out, in order to know the new technologies that exist for the operation of the same.

2. Approach to the problem. - Once the idea has been established, the problem is presented, what is needed and how it is possible to make use of the bases already mentioned in the previous point.

3. Initial immersion in the field .- Given the idea in conjunction with the approach of the problem, an inquiry is made in the area to be worked, what is intended at this stage is to know all the means where it is going to Develop the project and have the necessary relationships to carry it out. It is also sensitized with the environment in which the project will take place and identify the information that will be of assistance to the investigation, and also, verify its feasibility.

4. Conception of the study design. - This phase is where the previous bases must be in order to be able to carry out a research design to carry out the project. Conception provides depth to information, dissemination, interpretive wealth, contextualisation of the environment and experiences. It also provides a current, natural and holistic view of phenomena as well as flexibility.

5. Definition of the initial sample of the study and access to it.- In this phase only some parts of the collected research are taken, as it is not intended to generalize the results of the study. They are not taken as statistical data, but the results obtained in the sample are taken as individual cases of a population.

6. Collection of data.- In this phase of data collection, it is based on gathering experiences and information that will be useful for the development of the project. Here the person is in charge of carrying out the research by collecting the data. The researcher is in charge of collecting the data and relies on several techniques that are developed during the investigation.

This means that data collection is not done with instruments that are already pre-established, but rather that the researcher begins to learn through the observation and descriptions of those involved and creates means to collect and record the data. They are going on as the project progresses.

7. Analysis of the data.- At this stage, the analysis of the information collected does not begin with anticipated ideas about how the concepts or variables are related. Once the data collected in written, verbal, or audiovisual form have been recruited, they are integrated into a database that is composed of text and visual elements, which is analyzed to determine the meanings and interpretation and thus be able to describe the phenomenon studied from the point of view of the people involved. Descriptions of people are also integrated with those of the researcher who collected the information.

8. Interpretation of results.- From the collection of the data, an interpretation of them has to be made, at this stage after the development of the project, the analysis of the data is elaborated and translated into a personal tone, which The people involved can access and understand.

9. Preparation of the results report.- Finally, a report should be made in which all phases are presented with their results, through different means, such as graphs, matrices, maps, photographs, texts, videos, Audios, etc..

Development

Nowadays, society needs students to transform themselves with their studies acquired throughout their lives in engineers, doctors, scientists, etc., who may be able to solve the problems that society requires. The unvarying advances of all branches of study in the world present new challenges and create even greater opportunities for problem solving through technology.

These problems are not academic, but technological; So that the solutions presented by the students in the technological area, will make it possible. This makes the challenge even more challenging, as it is not enough for students who graduate from the upper middle to choose technology-related careers at a university.

This does not show lack of capacity for the new students by the Technological Universities, what reflects is the lack of really interested applicants that are qualified. In short, we would not have the students required in the next generation to solve the problems of tomorrow, unless the lack of solvers are directly directed to the present.

Many organizations are creating programs designed to appeal to students in the study of science and technology. The Technological Universities of the country, have found that robotics is a very strong platform to attract and maintain the attention of students. It is for this reason that the Technological University of the South of the State of Morelos (UTSEM) decided to openly open the Robotics workshop for the Information and Communication Technologies.

Figure 2 Robotics Workshop at UTSEM

Robotics captures the attention of this generation of students who is powerfully competitive and constitutes a good combination of programming, applied physics, digital prototype design and mathematics, which integrate problem solving, fostering teamwork and strengthening leadership.

Due to this, the Technological Universities are growing in enrollment, more and more students are interested in this Robotics program, since they inspire them in different branches such as science, mathematics, technology and engineering, Related to education and the existing professional careers.

While Robotics exists throughout the world, those in the VEX Robotics community have come up with extraordinary challenges that are easy and inexpensive to establish and implement.

The VEX Robotics design system helps motivate students to a higher level. The system is used as a robotic platform in a classroom that is designed to sustain creative advancement in robotics and knowledge of education in all areas.

The use of the pre-manufactured material, transforming into the easy assembly of a metal structure, intuitive VEX mechanical parts, combined with a powerful range of user-programmable microprocessors to control them, leads to great design possibilities. (VEX, 2016)

Figure 3 VEX Robotics Kits

The prototype of the robot began to be designed in the Robotics Workshop within the Technological University of the South of the State of Morelos, which is carried out for students in the area of Information and Communication Technologies, this workshop consists of the Students put into practice their knowledge that they acquire throughout their career, such as programming and electronics.

The harvester robot will be used inside the UTSEM for the Sustainable and Protected Agriculture Race, since there is a space where the students sow and at some point they have to collect the fruits, this robot will be of help for the two races mentioned above, Since it is beginning with a prototype and according to the needs, will be improved in the aspects that is required.

Figure 4 Space of planting in the UTSEM

In the robotics workshop the VEX line is used, which has kits which offer very good quality parts. The finishes of the mechanical parts and gears are the best that exists in the field of educational robotics. The VEX kits are robust, as their metal parts allow very compact constructions and are not considered in the toy line, but are used more in the professional field.

Figure 5 Parts to be used for the robot

For the design of the robot harvester, the caterpillars were needed, since they are the ones that allow a better adhesion to the ground. The construction of the robot will be all terrain, the tread like a tank allows the robot to overcome difficult terrain.

It also allows its conveyor belt to pick up objects, jump over obstacles and drive through soft sand or spongy surfaces. For the armature of the track, it was necessary to have tread links, as well as the tread, bogie wheels, screws of the support wheels and the locking nuts.

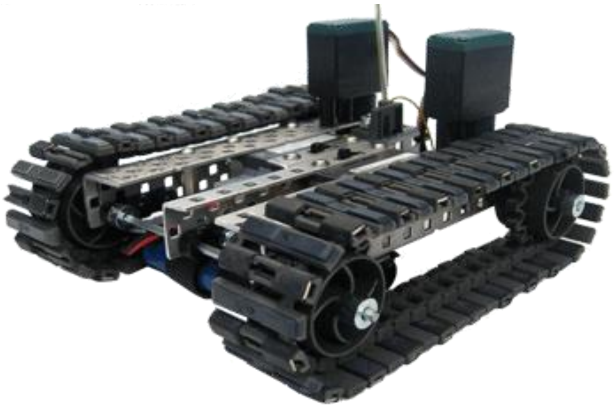

Figure 6 Robot tracks (VEX, 2016))

The robot must harvest the fruits with one arm, to release them in a basket that will lead from the front. In addition, an evaluation of the movement and utility of the robot should be made regarding the distribution of plants in the field space.

The robot will be composed of sensors, sensors provide the robot with the ability to detect several things in their environment. The sensors are the eyes and ears of the robot, and can always be available in the robot to operate independently of human control.

You will have a touch sensor, which will detect if it is the fruit you are taking, it will advance and when the sensor is activated, the robot will turn its motor and take it until it is started. It will consist of six engines. Two engines will be the base of the robot, which make the robot advance, the third will be in the arm to make it rise and fall, and the fourth engine in the clamp that will take the fruit.

The robot will have a simple bumper switch that will allow the switch to have impacts without any damage happening to it. This bumper also provides feedback to the microcontroller. Its functionality is pre-programmed by VEX.

Figure 7 Bumper(VEX, 2016)

It will have an arm that will have a pair of limit switch sensors built for VEX Robotics Design System. The switches send a signal to the microcontroller when they are in motion. These switches are used to signal when the robot arm has reached the top or bottom of its movement.

The robot uses potentiometers, with them the position and direction of its rotation can be determined. The use of these sensors will be to achieve an analogous behavior of an angular position. This measure can help to understand the position of the robot arms or other mechanisms.

Figure 8 Potentiometers (VEX, 2016)

The robot must measure distances, so it is recommended that you use the ultrasonic range finder. This is programmed the cortex so that the robot detecting the obstacle, can move the arms and collect the fruit.

Handling of the robot can be done through the movement controls by means of a person, but it will also be programmed to perform its movements autonomously.

Figure 9 Ultrasonic range finder (VEX, 2016)

Results

Thanks to the design of the harvester robot in the robotics workshop within the Technological University of the South of the State of Morelos has been able to increase in the students of the Information and Communication Technologies Career the motivation and creativity of each one of them, Enrollment has grown significantly because they consider the Robotics workshop as a platform in which they can exploit their knowledge and ideas, bring their theoretical part of their areas of study into something practical and real that can be useful in society.

Figure 10 Construction of the robot in the Robotics workshop.

As for the Sustainable and Protected Agriculture Career will be a support for the collection of the fruits, since the robot can carry out the arduous task that they face in the practices.

Figure 11 Crops in the UTSEM.

Aknowledgement

For Engineer Hermann Grafe, German belonging to "Senior Experten Service" (SES), a German industry foundation for international cooperation and public utility organization. Who traveled from Germany to support and share their experiences in Robotics and Internet of things with the students and teachers of the Information Technology and Communication Career of the Universidad Tecnológica del Sur de Morelos.

Conclusions

Universities today have the mission of preparing students to play roles in an increasingly technological society. In addition, studies say that new skills and abilities are needed to meet the needs of today's society.

Robotics emerges as an innovative didactic resource, which favors the investigation of knowledge in different areas, such as mathematics, engineering, science, programming, etc., from the infantile level to the university level.

Educational robotics is currently focused on the use of this technological resource by the teacher as an incitement factor, to guide the student to the development of their skills such as autonomy, initiative, commitment, creativity, teamwork, Self-esteem and interest in research. (Miglino, 2014)

The robot harvester is tested, the pieces chosen in the design of the robot have been appropriate. As a proposal for improvement will be to combine the management of the robot with the Internet of things to be able to control it from a device. It is thought to have a measurement tool automatically in the harvesting robot, which when it is sent to the area of seed, it will be able to read what the plants require, which will allow to monitor the growth of the crops.

References

Figueroa, D., et al. (2015). Sistema de Información como apoyo al proceso de Titulación de alumnos de la Universidad Tecnológica del Sur del Estado de Morelos. Revista de Sistemas y Gestión Educativa. 2-3:412-418.

Hernández R., Fernández, C. y Baptista, P. (2006). Metodología de la investigación. Mc Graw Hill Interamericana.

Miglino Orazio, Hautop Henrik L. Cardaci Maurizio, "La robótica como herramienta para la educación", [online], 2014, Recuperado el 26de septiembre de http://www.donosgune.net/2000/dokumen/EduRobSp.pdf.

RobotC 2016 (s. f.). En robotc.mx Recuperado el 25 de enero del 2016, de http://www.robotc.mx/.

Sampieri, R. (2010). Metodología de la Investigación. (M. G. Hill, Ed.) México, México: Mc Graw Hill.

UTSEM 2016 (s. f.). En Antecedentes de utsem-morelos.edu.mx Recuperado de http://utsem-morelos.edu.mx/index.php/2015-07-08-15-49-39/antecedentes.

UTSEM 2016 (s. f.). En Inicio de utsem-morelos.edu.mx Recuperado el 19 de enero del 2016, de http://utsem-morelos.edu.mx/index.php/2015-07-08-15-56-25/88-impulsa-la-utsem-talleres-culturales.

VEX 2016 (s. f.). En Conócenos de vexcompetition.es Recuperado el 25 de enero del 2016, de http://www.vexcompetition

Article **ECORFAN Journal**
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Gripping robotic system composed by a pair of robots petit

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Abstract

In this development a gripping system is presented, it is built with 2 petit robots, a goal is to execute object grasps by using the couple of petit robots as robotic fingers. For the construction of each petit robot is taken as a basis, a design previously developed. MATLAB® has been used to get mathematical models of the direct kinematics of the finger. Graphical User Interface (GUI) is also programmed in MATLAB®. Main goal of this development is showing feasibility on one hand use of petit robots designed earlier and on the other hand, customizing GUI developed for single petit robot. To provide movement to joints, servomotors have been used. Considering that each petit robot is composed by combination of 4 degrees of freedom, one finger has four servomotors to actuate every one of them. Graphical user interface is built with all components needed to command all 8 servomotors of whole system.

Petit robot, gripping system, modeling, design, interface, simulation

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Citation: FERNÁNDEZ-RAMÍREZ, Arnoldo, CUAN-DURÓN, Enrique, GARCÍA-ANDRADE, Roxana and URQUIZO-BARRAZA, Elisa. Gripping robotic system composed by a pair of robots petit. ECORFAN Journal-Democratic Republic of Congo 2016, 2-3: 10-18

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Introduction

Different developments, on the theme of petit robots, have been held in the Technological Institute of Nuevo Leon. The goal pursued is developing more complex robotic systems with a good relationship between versatility, mechanical complexity, cost and ease of use, among other related aspects.

This development is on a gripping system. It has been proposed to design a prototype that mimics the movements of grasping or grip with 2 fingers of the human hand. It is an interesting topic, to complement training in mechatronics, the project was held at the Technological Institute of Nuevo Leon in order to contribute further to the design of a robotic hand. The proposed system is a multi gripping robotic system. It has 4 servo motors in each finger, to achieve the movements of human fingers.

This prototype has been designed so that each petit robot has individual movements and movements together, which allows a variety of applications.

In this project, the study of direct and inverse kinematics has been made. The latter allows to know the trajectories of each robotic finger, which gives the possibility to perform simulation and command system.

The gripping system, consisting of two anthropomorphic fingers, which are commanded by the graphical user interface designed with the MATLAB® software. The use of robotic fingers predesigned enables the movement obtained is anthropomorphic, ie the petit robots, which form the gripping system, move like human fingers.

The aim of this paper is to show that you can get complex robotic systems from a petit robot designed previously.

Background

In (Jiménez Villalobos & Ramírez De La Cruz, 2005), the construction of a robotic arm three DOF (Degrees of Freedom) type PUMA (Programmable Universal Manipulator for Assembly) is presented.

Equations both direct kinematic model and the inverse kinematic model are presented. Using the Lagrange equations of motion, equations of the dynamic model are developed. In this robot architecture, a pair of joints with parallel axes is observed.

Immediately in the work developed in (Cimadevilla Lajud & Pérez Herrera, 2006), the reproduction of some limbs of human beings either for medical or industrial purposes, are mentioned. Spatially hand has become the subject of research, because it is important for everyday activities, robotic hands have been built, but until today has not been achieved imitate his skill.

In (Aguilar Acevedo & Ruiz González, 2011) the direct kinematic model is shown. The geometrical representation of the elements of the kinematic chain of the effector relative to a fixed reference system, using the methodology Denavit-Hartenberg of modified, is used. 4 GDL robot is modeled.

In the part of the inverse kinematics transform is critical specifications assigned to the robot movement in its operating space, in joint movements that allow such movement.

The inverse kinematics solution is reduced to a planar motion with 3 GDL, which has a redundant degrees of mobility with respect to the position of the end point of the robot, this because the final orientation is not considered.

Considering the existence of at least one element that specifies the orientation of the robot is possible to find a solution in closed form from a geometric analysis of the robot.

A project that involves the design, construction and control of a manipulator arm 4 degrees of freedom is described in (Cuevas Ramírez, Ramírez Vargas, & Cruz Hernández, 2012). The project is divided into three stages, the first is the design and mechanical construction of the robot manipulator, the second is the implementation and deployment of the control system and the third is for the adaptation of the manipulator arm to a mobile robot to have a robot exploration and security.

A description of the mechanical hand called MA-I (Artificial Intelligent Hand) as part of an integrated experimentation and testing strategies apprehension and object manipulation system is presented in (Suárez & Grosch, 2003). The basic configuration of the hand is 4 fingers with 4 degrees of freedom (DOF) each one of them.

First designs and construction of mini robots are presented in (Hernández Hernández, Garcia Andrade, Fernández Ramírez, & Cuan Duron, 2014; Hernández Hernández, Garcia Andrade, & Fernández Ramírez, 2014), then in (Fernández Ramírez, Cuan Duron, Garcia Andrade, & Urquizo Barraza, 2015) the petit robot for construct more complex robotics systems is introduced.

Kinematics

Forward kinematics

The direct kinematic model is the relationship that determines the vector **x** of operational coordinates corresponding to a given robot configuration **q**.

This model is expressed as:

$$x = f\,(q) \qquad (1)$$

Petit robots Forward kinematics

In table 1, DH modified (Khalil, W.; Kleinfinger, 1986) parameters of the first petit robot are shown.

Eslabón	α_i(°)	d_i(cm)	θ_i(°)	r_i(cm)
1	0	0	θ_1	0
2	90	0	θ_2	0
3	0	3.6	θ_3	0
4	0	3.5	θ_4	0
5	0	1.5	0	0

Table 1 DH parameters for the first petit robot.

DH modified parameters of the second petit robot are shown in table 2.

Eslabón	α_i(°)	d_i(cm)	θ_i(°)	r_i(cm)
1	0	0	θ_1	0
2	90	0	θ_2	0
3	0	3.6	θ_3	0
4	0	3.5	θ_4	0
5	0	1.5	0	0

Table 2 DH parameters for the second petit robot.

These parameters of each link i, are substituted into the following formula:

$$
{}^{i-1}T_i = \mathrm{Rot}\,(x, \square_i)\,\mathrm{Trans}\,(x, d_i)\,\mathrm{Rot}\,(z, \square_i)\,\mathrm{Trans}\,(z, r_i)
= \begin{bmatrix} C\theta_i & -S\theta_i & 0 & d_i \\ C\alpha_i S\theta_i & C\alpha_i C\theta_i & -S\alpha_i & -r_i S\alpha_i \\ S\alpha_i S\theta_i & S\alpha_i C\theta_i & C\theta_i & r_i C\alpha_i \\ 0 & 0 & 0 & 1 \end{bmatrix} \qquad (2)
$$

Where S is the sine function and C the cosine function.

The prototype of the gripping system shown in Figure 1.

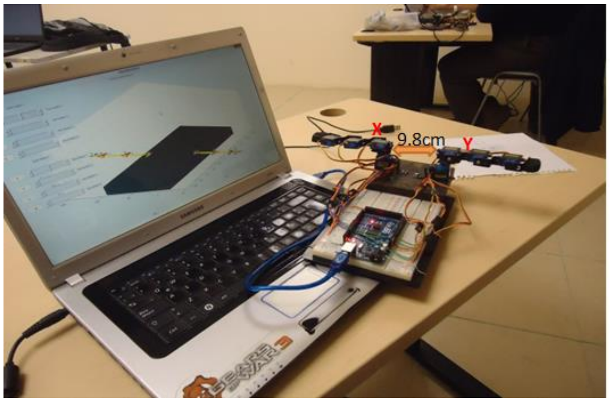

Figure 1 The gripping system.

Homogeneous transformation matrices in numerical form below:

For the first petit robot with $\theta_1 = \theta_2 = \theta_3 = \theta_4 = 0$, $d_3 = 3.6$ mm, $d_4 = 3.5$ mm and $d_5 = 1.5$ mm.

$$ {}^{0}T_1 = \begin{pmatrix} 1 & 0 & 0 & 0 \\ 0 & 1 & 0 & 0 \\ 0 & 0 & 1 & 0 \\ 0 & 0 & 0 & 1 \end{pmatrix} \qquad \mathbf{(3)} $$

$$ {}^{1}T_2 = \begin{pmatrix} 0 & -1 & 0 & 0 \\ 0 & 0 & -1 & 0 \\ 1 & 0 & 0 & 0 \\ 0 & 0 & 0 & 1 \end{pmatrix} \qquad (4) $$

$$ {}^{2}T_3 = \begin{pmatrix} 1 & 0 & 0 & 3.6 \\ 0 & 1 & 0 & 0 \\ 0 & 0 & 1 & 0 \\ 0 & 0 & 0 & 1 \end{pmatrix} \qquad (5) $$

$$ {}^{3}T_4 = \begin{pmatrix} 1 & 0 & 0 & 3.5 \\ 0 & 1 & 0 & 0 \\ 0 & 0 & 1 & 0 \\ 0 & 0 & 0 & 1 \end{pmatrix} \qquad (6) $$

$$ {}^{4}T_5 = \begin{pmatrix} 1 & 0 & 0 & 1.5 \\ 0 & 1 & 0 & 0 \\ 0 & 0 & 1 & 0 \\ 0 & 0 & 0 & 1 \end{pmatrix} \qquad (7) $$

For the second petit robot with $\theta_1 = \theta_2 = \theta_3 = \theta_4 = 0$, $d_3 = 3.6$ mm, $d_4 = 3.5$ mm and $d_5 = 1.5$ mm son:

$$ {}^{0}T_1 = \begin{pmatrix} 1 & 0 & 0 & 0 \\ 0 & 1 & 0 & 0 \\ 0 & 0 & 1 & 0 \\ 0 & 0 & 0 & 1 \end{pmatrix} \qquad (8) $$

$$ {}^{1}T_2 = \begin{pmatrix} 0 & -1 & 0 & 0 \\ 0 & 0 & -1 & 0 \\ 1 & 0 & 0 & 0 \\ 0 & 0 & 0 & 1 \end{pmatrix} \qquad (9) $$

$$ {}^{2}T_3 = \begin{pmatrix} 1 & 0 & 0 & 3.6 \\ 0 & 1 & 0 & 0 \\ 0 & 0 & 1 & 0 \\ 0 & 0 & 0 & 1 \end{pmatrix} \qquad (10) $$

$$ {}^{3}T_4 = \begin{pmatrix} 1 & 0 & 0 & 3.5 \\ 0 & 1 & 0 & 0 \\ 0 & 0 & 1 & 0 \\ 0 & 0 & 0 & 1 \end{pmatrix} \qquad (11) $$

$${}^{4}T_{5} = \begin{pmatrix} 1 & 0 & 0 & 1.5 \\ 0 & 1 & 0 & 0 \\ 0 & 0 & 1 & 0 \\ 0 & 0 & 0 & 1 \end{pmatrix} \qquad (12)$$

Inverse kinematics

The inverse kinematic model allows for all possible solution configurations of a robot corresponding to a given effector location (operational coordinates). This model is usually called the closed form of the inverse kinematic model. There is not a general solution for this model:

$$q = f^{-1}(x) \qquad (13)$$

For the solution of inverse kinematics problem, in this paper, a geometric approach is used. A fixed relationship of dependency or coupling between the third and fourth joint is supposed, as mentioned in (Cimadevilla Lajud & Pérez Herrera, 2006), the relationship that is used is as follows:

$$\theta_4 = \left(\frac{2}{3}\right)\theta_3 \qquad (14)$$

Eq. 6 allows to reduce the problem of inverse kinematics to calculate intersections between two pairs of circumferences.

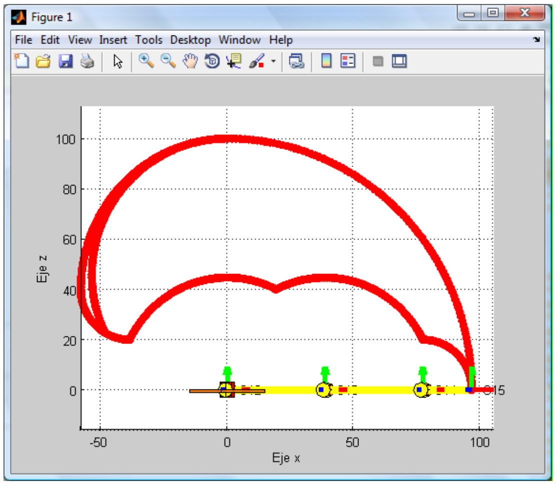

Figure 2 Petit robot´s workspace without the relationship.

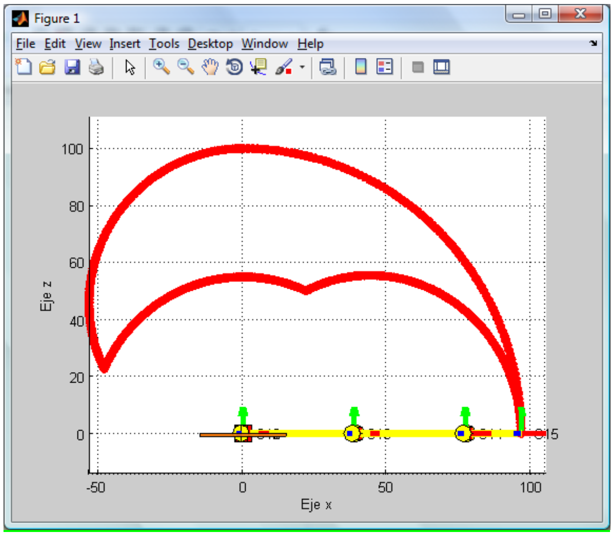

Figure 3 *Petit robot´s workspace with the relationship.*

In figures 2 and 3, x-z workspace projection allows to remark a reduction in the workspace due to Eq. (6).

Design and craftsmanship.

Petit robot geometry is generated using design 3D, in a computer aided design software, SolidWorks®. In Figure 4, all elements or components which are used to completely assemble the gripping system in SolidWorks® are shown.

In order to assemble each robot, aluminum phalanges are used, because this material is light and easy to be bent. The base which holds the system is made of acrylic.

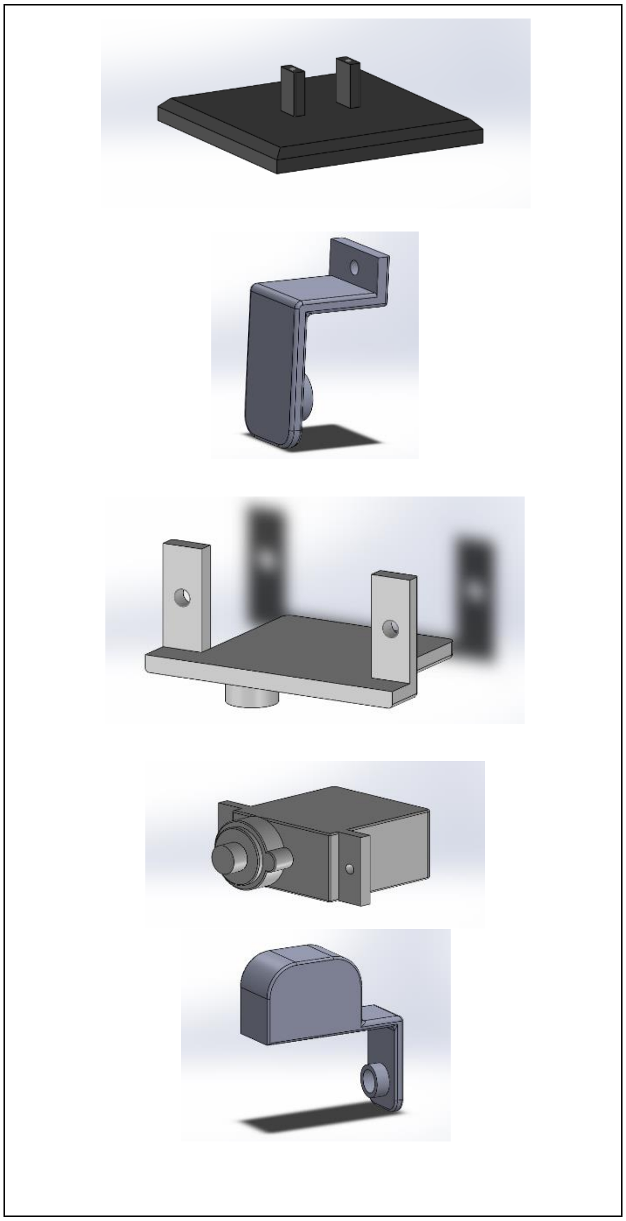

Figure 4 Gripping system components.

Once built each robotic finger, the gripping system has been assembled, and then in Figures 3 and 4, the system designed in some configurations is shown.

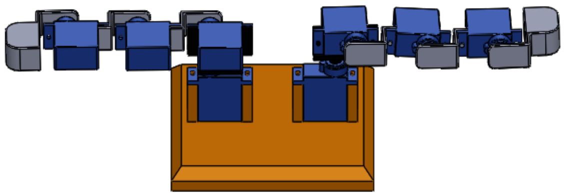

Figure 5 Home configuration **q** = [0º, 0º, 0º, 0º] for each petit robot.

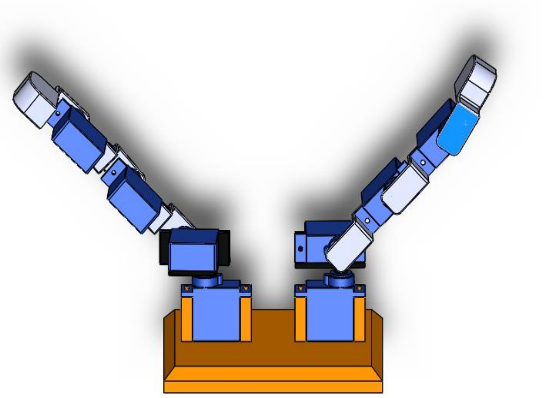

Figure 6 Configuration **q** = [0o, 45o, 0o, 0o] for each petit robot.

Graphical user interface (GUI)

MATLAB® has been used to code the graphical user interface. In order to represent phalanges and joints of the petit robot, lines and cylinders were used to represent them, respectively.

To interact with the interface, sliders are used, every one of them can change the value each robot joint variables. The value of each variable articulate can be seen in the corresponding edit box (Figure 5). Every time that user is interacting with this element, the forward or direct kinematic problem of the petit robot is resolved.

User can also interact with GUI via the edit boxes, in this case, first petit robot configuration and on second the position of the slider are updated. By the way, during this interaction, petit robot direct kinematics is solved.

In addition, the graphical user interface has edit boxes to display, numerically, the position of the end of the petit robot, using Cartesian coordinates.

The interface has buttons with the "+" and labels "-", which allow to solve the problem of inverse kinematics.

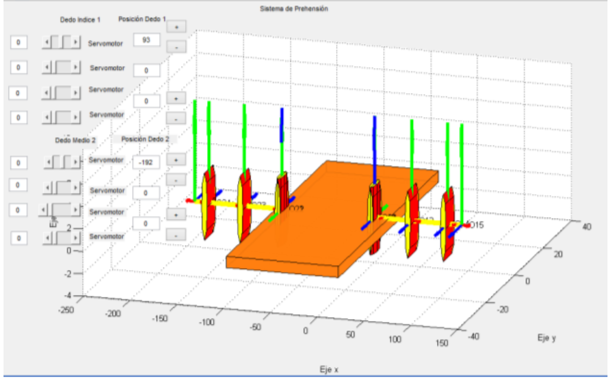

Figure 7 GUI gripping system with petit robots both in a **q** = [0°, 0°, 0°, 0°] configuration.

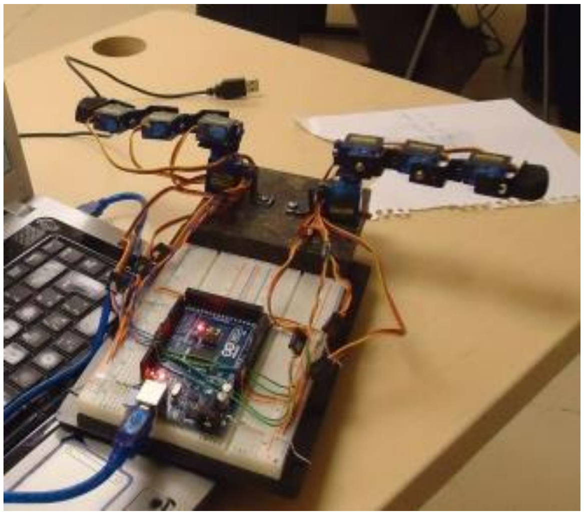

Figure 8 Gripping system with petit robots, configuration **q** = [0°, 0°, 0°, 0°] each of them.

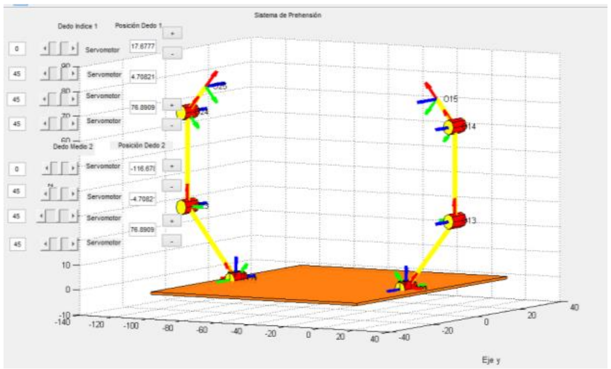

Figure 9 GUI gripping system with petit robots both in a **q** = [0°, 45°, 45°, 45°] configuration.

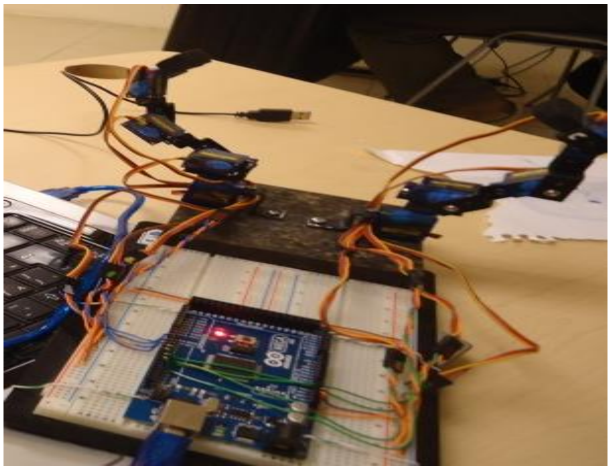

Figure 10 *Gripping system with petit robots, configuration* ***q*** *= [0°, 45°, 45°, 45°] each of them.*

The software implemented in Arduino Mega®, to control the petit robot through the graphical user interface developed in MATLAB®, is able to read all the time all the interface type in the serial port of the computer.

Code

Gripping system´s code implemented in Arduino Mega® is shown below.

```
#include <Servo.h>
Servo servo[8];
int pin[8]={
  2,3,4,5,
  6,7,8,9};
```

```
void setup(){
  //servo[0].attach(3);
  for (int i=0;i<8;i++){
    servo[i].attach(pin[i]);
  }
  Serial.begin(9600);
}
int grados;
void loop(){
 if (Serial.available()){
    for (int i=0;i<8;i++){
      grados = Serial.parseInt();
      if(grados>0 && grados < 180){
        servo[i].write(grados);
        delay(50);
      }
    }
  }
}
```

Algorithm

MATLAB® application´s pseudo code is presented to briefly illustrate the operation of the graphical user interface.

01 Start Application

02 Initial Configuration q = [0 0 0 0] each petit robot

03 Updating the petit robots and resolution of the forward kinematics

04 Opening the serial port

05 Writing the initial configuration on the serial port

06 Close the serial port

07 Waiting user interaction

08 If value change in articular variable (slider or edit box)
09 Then update petit robots and solving the forward kinematics

10 Open serial port

11 Writing current configuration on the serial port

12 Close the serial port

13 If you click on "+" or "-"

14 Then solving inverse kinematics

15 Checking the validity of the solution and update petit robots representation

16 Opening the serial port

17 Writing current settings to the serial port

18 Close the serial port

In the current stage of development, a system of open-loop control is used. This is because sensors are not implemented or some method to quantify the error. Without feedback, for now, another control system cannot be used. The block diagram for each engine is shown in Figure 9.

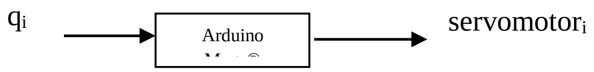

Figure 11 *Bl*ock diagram for each servomotor.

Results

A thesis, a system gripping prototype, and the graphical interface have been developed, as tangible results of this work.

The results allow us to move towards the development of more complex systems with petit robots and designing robots with different architectures.

Conclusions

A gripping system is designed and built at the Technological Institute of Nuevo Leon. A brief description of the objectives pursued in its design, the most relevant details of their mechanical structure, electrical and electronics, software developed for controlling the system are made.

This project is developed in the field of electronics and robotics, also integrating knowledge and expertise in programming Arduino Mega® and MATLAB®. The graphical user interface allows us to show the system simulation, in addition to observing real way, the solution of direct and inverse kinematics of each of the petit robots composing the system.

The goal of integrating a more complex system from the petit robots previously presented in (Fernández Ramírez et al., 2015) is fulfilled. The number of degrees of freedom manipulables is doubled and the graphical user interface is modified for this purpose. The petit robots gripping system move in anthropomorphic form.

References

Aguilar Acevedo, F., & Ruiz González, R. (2011). Redundancia cinemática en un dedo antropomórfico de 4 gdl, (5), 1037–1042.

Cimadevilla Lajud, H., & Pérez Herrera, J. G. (2006). Diseño de un sistema articulado emulando el movimiento de una mano. Tesis CENIDET.

Cuevas Ramírez, L. A., Ramírez Vargas, I., & Cruz Hernández, F. (2012). Análisis y construcción de un manipulador de cuatro grados de libertad, 1046–1056.

Fernández Ramírez, A., Cuan Duron, E., Garcia Andrade, R., & Urquizo Barraza, E. (2015). Development of a Petit Robot Suitable For Building Robotic Systems. UTSOE-Journal Multidisciplinary Science ISSN 2395-860X, 22–28.

Hernández Hernández, J., Garcia Andrade, R., & Fernández Ramírez, A. (2014). Experimentos con un dedo robótico y simulación. Pistas Educativas ISSN 1405-1249, 1073–1083.

Mathematical modeling: characterization of a proposal for the teaching and learning of multiplication and division

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Abstract

This is a work which has the purpose to provide input about a proposal for teaching Mathematics in particular multiplication and division, taking into consideration Mathematical modeling starting from a characterization and analysis from the educational reality. Currently, educational models focus on the students building mathematical knowledge through interaction with their environment, where the teacher intervenes as a guide who intentionally plans and teaches mathematical knowledge. Contrary, the results of our country in international assessments such as PISA 2012 (INEE, 2013) suggest that students demonstrate low levels of performance in learning Mathematics. So, it is necessary to set teaching strategies that involve solving problems and that at the same time they work as learning vehicles and not as an end in themselves. This study emphasizes that a child learns by observing, manipulating, validating and building. Some studies have shown that students must learn in relation to what they live day by day. It also shows strong aspirations to propose a possible alternative in the teaching of mathematics: mathematical modeling.

Mathematical modeling, mathematical problems, teaching and learning of multiplication and division

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Introduction

The present world forces the construction of different visions on reality and the different forms of problem solving using reasoning as a fundamental tool (SEP, 2011). Representing a solution involves establishing a set of symbolisms and correlations through mathematical language.

Knowledge of rules, algorithms, formulas and definitions will only be considered important insofar as students can use them in a flexible and reflective way to solve problems that are significant and relevant to them. In other words, it does not make sense to have a closed and linear mathematical language if at the moment of confronting a problematic one does not have the capacity to flexibilizar the language to give solution to situations that are exigible in its daily social development.

That is why it is necessary to carry a process of learning of mathematics in which it starts from the informal knowledge to enter into the formal mathematical language and its ramifications to arrive at the conventional one; In other words, to use what is learned in everyday life. The fundamental intellectual activity in these processes must have a basis in reasoning and logic and not only in memorization (SEP, 2011).

Currently the educational models focus on the students to construct mathematical knowledge through interaction with their environment, where the teacher is inserted as a guide, as the subject that intentionally plans and didactifica mathematical knowledge. However, our country's results in international tests such as PISA 2012 (INEE, 2013) indicate that students demonstrate low levels of performance in mathematics compared to most of the other countries evaluated.

In this way it is possible and pertinent to propose a teaching and learning of mathematics that involves different ways of solving a problem or the use of different strategies when facing problems of multiplication or division.

The teaching of multiplication and division algorithms in school reality in primary education

We are living in a world in which the impact of mathematics on social culture is very evident. Mathematical knowledge has been facing the adaptation of use of algorithms and operations for the various modern and current tools of the 21st century; For example, machines (some more sophisticated than others), interpretation on the stock exchange, (VAT, buying and selling currency, taxes, etc.), understanding the time, building a house, algorithms that make up the organization Digital on the internet, etc.

In this way, the influence that mathematics has for human development is clearly visualized. On the one hand, it is a science that serves to generate knowledge and perception, and; Complementing, is a system of instruments, products and processes that favor the exercise of a wide range of techniques and practices (Hernández Pina & Soriano Ayala, 1999).

One of the purposes of mathematics in primary school is to create a positive attitude towards students, and one of the means to achieve this is to help children experience intellectual pleasure through them. However, today and contrary to the above, children develop from primary education, a barrier based on the fear of mathematics (Gómez-Chacón, 2000). Within this barrier are introduced several problems such as the mechanical memorization of algorithms for Solving problems of multiplication and division at best.

This reality is what makes possible the need to achieve a series of actions to characterize the processes of knowledge construction in the mathematical field, with emphasis on the basic algorithms, in this case multiplication and division.

The problem is seen, in the rote use of a single form in the resolution of operations that involve division, multiplication or both. That is why one of the most important mathematical rules is broken: The most important thing is not to arrive at a solution, but the processes that the students follow when trying to find it. (Hernández Pina & Soriano Ayala, 1999).

Methodological perspective

Qualitative research has its origins in anthropology, seeks a holistic understanding, and puts the emphasis on depth (Bizquerra, 1989), based on it, is assumed as a methodological feature relevant to the present research work. The techniques of data collection that were used were the in-depth interview.

The interview consisted of open-ended questions where the teacher answered what he thought would be the procedure to learn and / or teach problematic situations regarding multiplications and divisions, explaining further how the result would be achieved. This served to gather information about their strategies in the development of basic operations and the understanding of problems.

The research that is presented was developed in a primary school located in the community of El Tepetate, Loreto, Zacatecas; In the framework of the days of professional practice for teachers in initial training of the 5th Semester during the school year 2015-2016 in the Degree in Primary Education. The subject of study for this stage of work is the teacher in charge of the groups of 3 ° and 4 °.

It is to be understood that in the second cycle of primary education one begins to know in depth the use of algorithms of multiplication and division.

Problem formulation

Central question

How to improve current skills, strategies, techniques or resources for teaching and learning multiplication and division in the third and fourth grades of primary education?

- Complementary questions ¿How to introduce the reflection and analysis in the different problems that entail the algorithm of the division and multiplication?

- What strategies lead to reflective learning through collaborative and / or individual work?

- How to get students to relate the two algorithms-multiplication and division-as something similar and in turn opposed?

Objetives

Identify and recognize the problems of the students through the diagnostic evaluation and the investigative and theoretical background to enable an improvement plan based on reflection, analysis and understanding.

Identify learning strategies where children understand the use of division and multiplication in everyday life.

Modeling the learning and teaching of mathematics. Current research perspectives

A child learns by observing, manipulating and constructing, from the behavioral view of teaching and learning mathematics (traditional teaching) is irrelevant.

Different research has shown that students should learn in relation to what they live day by day. Here we enter a situation that gives way to a possible alternative of response to the change of the teaching of mathematics: mathematical modeling.

Modeling in the mathematical education environment refers to the process involving the representation of reality by means of a mathematical model. There is often a distinction between approaches to modeling, on the one hand, we have applications and modeling for learning mathematics and, on the other hand, learning mathematics to develop skills in the construction of mathematical models. The first slope considers the use of modeling activities as a vehicle for the construction of mathematical concepts. And the second slope involves the application of mathematics to construct mathematical models (Guerrero Ortiz & Mena Lorca, 2015).

Modeling in the mathematical education environment refers to the process involving the representation of reality by means of a mathematical model (Guerrero Ortíz & Mena Lorca, 2015). But it should also be borne in mind that the use of modeling in school is shown in different ways according to the points of view from which the didactics are viewed (Trigueros Gaisman, 2009). The same author, quoting Freudenthal (1968), argues that, if mathematics really desires value, they must be attached to reality and relevant.

(Trigueros Gaisman, 2009) Emphasizes what Camarena 1999 and 2000 says: the modeling process is conceived as a whole and not as something partial, whose objective is the development of approaches to the way in which the Applied mathematics and not the development of concepts. The researches of Trigueros Gaisman emphasized that the anthropological theory of didactic (TAD) proposes that for each mathematical activity a modeling of the same one can be done.

Likewise (Sierra Delgado, Bosch Casabó, & Gascón Pérez, 2013) establish that the TAD postulates that all mathematical activity can be interpreted as an activity of study and production of praxeologies with the aim of answering certain problematic issues. This activity requires that the student (whether a student, a teacher or an investigator) has access to or, if appropriate, constructs certain appropriate mathematical techniques and can use, when required, a mathematical discourse to interpret, make sense and evolve Mathematical practice.

(Trigueros Gaisman, 2009), establishes that one of the objectives of this work is that students need to be able to solve a problem or situation in different ways.

In this case, the central objective of this research is emphasized: different ways of solving a multiplication or division operation. That although it is something very limitante to say it of that form would be necessary to include all the process that entails. The development of research involves all the steps that must be followed in mathematical modeling as mentioned (Herrera Villamizar, Montenegro Velandia, & Poveda Jaimes, 2012) cited by (Trigueros Gaisman, 2009):

The definition of the model: identify variables and constants of the problem, including the identification of what varies and what remains constant.

Formulation of the algorithm: establish relations between variables and constants through the concepts involved in the problem.

Develop the program: validate the "mathematical relationship" that models the problem, which is done by returning and verifying that it involves all the data, variables and concepts of the problem.

Complementing the previous arguments and relating them to the main theme (Calvo Ballestero, 2008), he mentions that the methodology used in teaching problem solving in mathematics is a key element for the satisfactory achievement of the contents in this subject. Therefore, by relating modeling as a teaching strategy to solve multiplication and division problems, it can have an effect on favorable learning outcomes. Unfortunately in the teaching of mathematics, analytical and reflexive thinking has been neglected, which has been replaced by memory and mechanization generated mainly by the repetition of exercises (Calvo Ballestero, 2008).

When making a recapitulation, in the midst of the continuous curricular transformations in our country, it is not enough to have specific knowledge and exercise its transmission. It is essential to build experiences and learning opportunities that enable new knowledge and skills in their application and socialization, both in the teaching activity: in the reflection, analysis and progressive innovation of professional practice, as well as in the impact that would be envisaged in better and Greater learning of content and mathematical understanding. In view of the above, mathematical modeling is assumed as a relevant methodology for teaching and learning mathematics, specifically in solving multiplication and division problems in the third and fourth grades of primary education (Salett Bienbengut & Hein, 2010).

Theoretical perspectives in teaching and learning multiplication and división

The importance of logic and reasoning in learning basic operations

The writings of Jean Piaget in his book "The conception of number in children" mentions that logic is the most solid criterion for defining numerical comprehension of children (Nunes & Bryant, 1997).

From here the bases of why pupils should keep in mind the order of numbers are highlighted. There needs to be a transitivity to understand the nature of the number.

The curious thing about mathematical reasoning is that it involves mixing a general logic. Anyone should understand that $1 + 1 = 2$ because a comparison is made in the order of numbers and is logically demonstrated. However, the development of mathematical logic (which in turn also develops reasoning) implies that it is related to its context. If the students are aware that daily they are involved in the use of the basic operations, the teacher needs to take the daily problems to the classroom to solve them in a reasonable way.

An intrinsic process of the student should be carried out where he asks questions, analyzes data, makes decisions and values his own knowledge. You need to develop your mental agility little by little to make small mental accounts involving addition and subtraction, to subsequently reach a complex level and develop operations of division and multiplication.

Development of mental calculation

Most of the calculation that is done daily outside of the school is mental. Many times the answer does not have to be exact, it is enough with an approximation. This type of calculation has certain characteristics:

- Can be done quickly
- It relies on a limited set of numerical facts
- Requires certain skills (counts, relocations, compositions, decompositions, etc.)

Certainly this is not a goal for school, sophisticated methods of mental calculation are inappropriate for children's minds, but that does not mean that from the outset the foundations cannot be laid to achieve at the end of schooling a dexterity, efficacy and Reasonable speed for the most common calculation situations (Gómez Alfonso, 2007).

Thus, from an early age in the introduction to mathematics, concentration, habit, attention, and interest should be involved to achieve favorable results in this type of calculation. An example of this is the operation of permanent activities of addition and subtraction operations beginning with numbers of a figure and increasing the difficulty according to the speed and agility of the student.

One of the bases of multiplication: The multiplication tables

A good mental calculus skill is not possible if good support points are not available. One of them is known as the tables. Thanks to them it is possible to calculate without worrying about the size of the numbers as soon as the methods that allow to reduce the manipulation of the numerical symbols are dominated to those that appear in them.

(Gómez Alfonso, 2007) It points out two ramifications as to how to teach the tables. One based on memorization or blind and the other based on personal strategies. In order to decide on the most appropriate line of action, it should be borne in mind that one approach leads to the other. Although this does not occur in both directions. The use of strategies may end up in memorization of results, but memorizing results not only does not lead to the design of strategies, but obstructs them.

Whatever the case may be, it should be pointed out that multiplication tables are a permanent exercise of mental calculation and a primary basis for initiating the basic operations of multiplication and division. Operations that to be able to solve them properly require a strong foundation in addition and subtraction, mental calculation, counting and reasoning. This is where all operations are articulated in a balanced way where basically multiplication is the sum of large numbers and division is the subtraction in equal parts of different types of numbers.

Introduction to multiplication and division

The introduction to multiplication and division does not mean knowledge of multiplication tables, or the mechanics of these operations; it is intended only to arrive intuitively at the concept of multiplication as a "special sum", that is, as sum of equal sums, and to the concept of division as a distribution of equal parts or as successive subtasks (Cascallana, 1993).

Product learning and division is the beginning of the study of a new structure. However, as already mentioned in the previous section, starting to work on multiplication and division requires that the student has a level of use and mastery of numbers, which knows its symbolization, all to a more complete degree than in Case of addition and subtraction.

Multiplying is iterating an amount, at its most intuitive level. To divide is to distribute a quantity in equal parts (Castro, Rico, & Castro, 2007). The dividend is the amount to be distributed and the divisor is the number of shares.

In the beginning of these two basic operations (Nunes & Bryant, 1997) they mention that, the teaching needs to concentrate on creating situations that serve as a bridge between the understanding of children and the new strategies that employ functional or scalar factors expressed in a multiplicative way. On the other hand (Castro, Rico, & Castro, 2007) they refer that we must leave two years or intermediate courses between the teaching of addition-subtraction and multiplication-division to strengthen the first two operations.

New methodology in the restructuring of learning and teaching mathematics: mathematical modeling

For some years now, restructurings in the curriculum and teaching strategies of mathematics have been processed, according to (Biembengut & Hein), among other aims, is to increase interest in its application in everyday situations, in addition Which visualize that learning is not just adding knowledge, rather it is assumed as a "process of growth", "Knowing is a process and not a product."

In mathematical modeling, the theme is unique and from it the programmatic content is extracted. It can be used even during the whole school period. As long as you have enough content to develop the program and do not exhaust the motivation of the students. The suggestion is that the method has the following sequence: justification of the process, choice of topic, development of program content, analogous examples - concept setting and evaluation and validation of results (Biembengut & Hein).

Process justification

It begins with a critical analysis on the conventional teaching of mathematics and shows the possibility of presenting the mathematical content from real situations, thus giving a practical sense.

For this the teacher exemplifies exposing a known mathematical model and directs his exposition in a way that clarifies what are the mathematical concepts and operations that become necessary for the understanding of the proposed situation. Above all, it is necessary to find effective ways to motivate students so that they voluntarily decide to actively develop learning.

Choice of topic

As the students are suggesting topics, a list is made on the board for a later election. The teacher can also use to interleave some topics (as a suggestion), mainly those that are already known in relation to the breadth of its contents. The choice of the subject by the students will make them feel participants in the process.

The performance of the teacher should be primarily focused on the use of strategies that facilitate the choice of a broad, motivating subject and on which, in a way, it is easy to obtain data or information. For example, construction of houses, corn plantation, travel in a trip, etc.

Development of pragmatic content

We will say for example that the students chose the theme of building houses, the teacher should look for strategies to develop the content correctly. The teacher can start with a detonating question: What is necessary to build a house? Then you can start a topic of geometry based on the construction of a house and developing subtopics of basic operations, perimeter, area, etc.

Evaluation

A formative, progressive and permanent evaluation is applied in which children are free to explain and to base their answer, then it is there that the knowledge is constructed because the other children will be able to validate that their work is correct confirming or mathematically rejecting the arguments and the Teacher who will be a mediator will have them prove using the learning they have developed.

First approaches to relevant categories for mathematical modeling

Mathematical knowledge. Conceptualization on multiplication and division

The domain of mathematical content is a fundamental element in the learning and teaching of mathematics. With what knowledge of structure, subjects and mathematical practice can a mathematical problem be solved? Thus, within the interview that was applied to the professor subject of the investigation were verified some of the concepts that has on the multiplication and division.

1 What is multiplication?

2 It is to duplicate one or many times an amount. It can also be through the same

3 sum.

4 What is division?

5 Disbanding an amount in equal parts or sharing an amount.

One of the mathematical competencies of teachers is to have the ability to understand conceptually; So that in later occasions it can represent and relate different parts of the mathematical content and use it in problem solving (Chamorro, 2006). As we can observe in the questions that were asked to the teacher, he answers correctly, indicating the knowledge he possesses about the mathematical content.

Troubleshooting

Solving mathematical problems depends on two fundamental aspects: the operation as theory / practice at the same time and the implication of solving applied problems. The following sections will analyze in depth the development of how an operation is solved depending on its location: solitary or in a situation.

Individual operations

Individual operations can be taken initially as a teaching of the theoretical to the practical without a present situation, it is important not to assume it as isolated execution exercises of practical, mathematical and probably understanding comprehension, rather as knowledge of structure and Mathematical practice that at a certain moment is pertinent to the knowledge of the mathematical content. Taking the code P1E1 we placed the procedure that followed the teacher to solve some solitary operations on the multiplication and division:

6 How much is 28x4?

7 We initially placed the operation in order on the board to solve it. After

8 multiply 4x8 and put the number of units below the line. The amount

9 of the hundreds put it above 2, then multiply 4x2 and result

10 add the number that we have above the 2, then lower the number below

11 the line and we have 112.

In the evidence, the teacher uses the technique of vertical multiplication, something that is commonly done in schools Why not teach multiplication by the method of the ancient Maya or by "gelosia" as mentioned (Sierra Delgado, Bosch Casabó, Gascón Pérez, 2013), who determines another method and uses the sum table.

However, whatever the method to be used in multiplication, to improve the appearance of this, it is proposed to use mathematical modeling.

As already stated, mathematical modeling improves teaching techniques through context or real situations. In this process the context is part of the learning process (Trigueros Gaisman, 2009).

With regard to the division is the following part of the interview:

17 How much is 65/5?

18 We put the corresponding numbers in the "little house" and divide 6/5, making the

19 Question: How many times does 5 fit in 6? As it is one, we put the one in the

20 ratio and multiply 5x1, then 5 we put it under 6 and subtract.

21 One is left and we get down to 5, then we have the number 15, now we repeat: How many

22 times it fits the 5 in the 15? The answer is 3 and we put it in the quotient, we multiply

23 and we subtract and as the subtraction is 0 the operation is finished.

The procedure of this basic operation is common to see in elementary school. In this respect we cannot reiterate that in order to comply and do this technique correctly we must first be clear about the iterated sum and multiplication tables, as well as the notion of apportioning. Usually this operation can be used by defragmenting the dividend and making smaller distributions. However, procedural use as planned is meant to be memorized. Here comes the ability of each student to modify the procedure according to their knowledge and mathematical skills.

Emphasizing that the teacher must be aware of how students do and validate through the socialization of mathematical knowledge in play.

Problems applied

32 Ulysses goes to the store and buys 9 sabritas at a price of $ 6.00 and 15 sodas with a

33 price of $ 12.00 How much did you spend at the Ulysses store?

34 This problem initially involves an iterated sum of 9 times 6 and 15 times 12 o

35 a multiplication obtaining 54 in the first account and 180 in the second. So

36 if you ask the total price to pay we must make a final sum of 54 + 180 for

37 get the result they ask us leaving a total of 234

38 Anahí has a bag of sweets, the moment she decides to count them she discovers that she has

39 40 candies. If you decide to distribute them among your 8 friends. How many sweets will you touch

40 every friend of Anahí?

41 It is necessary to take the data that they give us and to analyze that if it wants to divide in leaving we must

42 make a division. Then take two facts: How much are we going to split? Y

43 Between how many? Reading the problem again we are going to divide 40 sweets between 8

44 friends, then we execute the division having a result of 5.

We can see that the teacher concentrates on the location of data and the analysis of what he asks. We must be clear that, at some point, the information contained in some problem approach may exceed the student's cognitive resources or away from the schemes that were relevant in simpler cases (García Alcalá, Vázquez Maldonado, & Zarzosa Escobedo , 2013). In this case students can add up the amounts that they have without paying attention to what is asked.

The improvement of these types of problems is that they have relevance to children's lives. In this case the mathematical modeling comes into play and thus through this, the students generate a logical reasoning for which it facilitates the understanding of the problem. In the case of Ulysses' situation, the teacher briefly introduces him because he already knows what he has to do. A student reading it and seeing that a real and everyday situation is present can solve it easily or with less help.

The student can solve it initially with the knowledge that he has no matter how long or short the procedure. What is valid is the result and the process that followed. Arguments such as (Cascallana, 1993) in his research mention that students need the time needed to solve their problems and adequate patience to take the error as new knowledge.

Conclusions

The teaching of mathematics is a subject that is taking a lot of relevance for the evaluation results in the primary schools of the country. Students see math as a headache and many of them contain a barrier to learning about this subject. This can be, among other factors, a traditional teaching of mathematics in which improbable data, unrealistic situations and the emphasis on mechanical memorization are induced.

The theoretical discussion, which contemplates some researches such as those presented in this work, show that mathematical modeling, based on real situations, on topics of interest in children and on various procedures for improving the themes of mathematics. We must start from real situations to demonstrate a topic, for example, the case of basic operations improvement so that students know that mathematics serves daily life.

Likewise, the justification and explanation in each procedure is fundamental to validate the constructed mathematical knowledge, besides serving as feedback. In the case of multiplication and division, since the operations are contrary and at the same time related, justification serves in two aspects: to justify the result and to feed back the opposite operation.

In this way, an initial response is formed, as a characterization, on the improvement of multiplication / division teaching through mathematical modeling, which responds to different issues such as problem justification, collaborative work as a means to socialize strategies Of procedures and the use of different real situations that involve all the basic operations through themes, for example, the construction of a house.

References

Biembengut, M., & Hein, N. (s.f.). Modelo, modelación y modelaje: métodos de enseñanza-aprendizaje de matemáticas. Brasil: Universidade Regional de Blumenau.

Bizquerra, R. (1989). Métodos de investigación educativa. Barcelona: Ceac.

Calvo Ballestero, M. (2008). Enseñanza eficaz de la resolución de problemas en matemáticas. Educación, 32(1), 123-138.

Cascallana, M. (1993). Iniciación a la matemática. Materiales y recursos didácticos. Madrid: Aula XXI/Santillana.

Castro, E., Rico, L., & Castro, E. (2007). Números y operaciones. Fundamentos para una aritmética escolar. Madrid: Síntesis.

Chamorro, M. (2006). Comprensión conceptual. En M. d. Chamorro, Didáctica de las Matemáticas (pág. 15). Madrid: PEARSON.

García Alcalá, A., Vázquez Maldonado, J., & Zarzosa Escobedo, L. (2013). Solución estratégica a problemas matemáticos verbales de una operación. El caso de la multiplicación y la división. Educación Matemática, 25(3), 103-128.

Gómez Alfonso, B. (2007). Numeración y cálculo. Madrid: Síntesis.

Gómez-Chacón, I. (2000). Matemática emocional. Los efectos en el aprendizaje matemático. Madrid: Narcea.

Guerrero Ortíz, C., & Mena Lorca, J. (2015). Modelación de la enseñanza de las matemáticas: Matemáticos y profesores de matemáticas, sus estrategias. Revista Electrónica de Investigación en Educación en Ciencias, 10(1), 1-14.

Hernández Pina, F., & Soriano Ayala, E. (1999). Enseñanza y aprendizaje de las matemáticas en Educación Primaria. Madrid: LA MURALLA, S.A.

Herrera Villamizar, N. L., Montenegro Velandia, W., & Poveda Jaimes, S. (2012). Revisión teórica sobre la enseñanza y aprendizaje de las matemáticas. Revista Virtual Universidad Católica del Norte(35), 254-287.

INEE. (2013). México en PISA 2012. México: INEE.

Lizarde, F. E., Hernández, G. F. J., & Loera, S. S. (2015). Problemas de enseñanza: una alternativa para la construcción del conocimiento especializado del profesor de matemáticas. XIII CNIE. Chihuahua. COMIE

Nunes, T., & Bryant, P. (1997). Las matemáticas y su aplicación: La perspectiva del niño. Oxford: Siglo XXI.

Salett Bienbengut, M., & Hein, N. (2010). Modelación matemática y los desafíos para enseñar matemática. Educación Matemática, 16(2), 105-125.

SEP. (2011). Plan de Estudios. México: SEP.

Sierra Delgado, T. Á., Bosch Casabó, M., & Gascón Pérez, J. (2013). El Cuestionamiento Tecnológico-Teórico en la Actividad Matemática: el caso del algoritmo de la multiplicación. Boletim de Educação Matemática, 27(47), 805-828.

Trigueros Gaisman, M. (Enero-Marzo de 2009). El uso de la modelación en la enseñanza de las matemáticas. INNOVACIÓN EDUCATIVA, 9(46), 75-87.

Article

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Locomotion planning using OBs for a Robot Nao

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Abstract

Robotics in industry is a reality since 1990's. There are different kinds of robots working in manufacturing cells, industrial processes, medicine, servicing and even entertainment. However, robotics in daily live is at an early stage, this kind of robotics applications is called servicing robotics. There are still several challenges in servicing robotics to solve such as human-robot interaction, real-time 3D environment modelling, and autonomous locomotion planning, among others. In this work a methodology for locomotion planning for a humanoid robot Nao is presented. The main contribution of this work is that our planner takes into account three kinds of locomotion: frontal, lateral and four-contact points based. These are directly considered as part of the locomotion plan. In order to verify the proposed method three scenarios are tested on simulation. Finally, a discussion on the results is also presented.

Locomotion, humanoids, motion planning

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Introduction

Robotics in the industry has had significant success in recent years, its applications encompassing the automotive industry, auto parts, electronics assembly, pharmaceutical industry, aeronautics and aerospace as well as entertainment. In a report from the International Federation of Robotics IFR, World Robotics Report 2016, it is mentioned that 36,000 new robots were installed in the USA, Canada and Mexico; It also indicates that from 2010 to 2015 the main robot developers from the USA, Europe and Asia installed 80 000 robots.

However, one area of opportunity is service robotics, which refers to the use of robots in everyday human environments. Some efforts by the industry have been made to bring robotics to the home such as the robot robots iRobot, company founded by Rodney A. Brooks. Also humanoid type robot robots have come to market as the Softbank Robotics Pepper robot. Service robotics is one of the areas that are still under development and requires extensive study to be successful as industrial robotics. Within the challenges of service robotics are the human-machine interaction that resembles how humans interact: voice, body and facial gestures; Also the locomotion, planning of movements and the avoidance of obstacles, among others. The Robot Nao of Softbank Robotics is one of the most successful humanoid type robots, however development of new applications and usage is difficult due to its fragility in locomotion, (Who is not?). Therefore, this aspect should be further explored. In this paper, we present a locomotion planner for Nao that includes and exploits its locomotion capacities. Locomotion planners have been developed for different robotic platforms such as ASIMO, HRP2, HUBO, among others (Kajita et al., 2003), (Masato & Kenichi, 2007), (Ill-Woo et al., 2006).

Also, theoretical planners have been developed that in a real situation are difficult to execute successfully (Hauser et al., 2008). The robot has no integrated locomotion system that can be moved forward, backward, lateral, front and back following curved trajectories; In this work we propose a locomotion planning system that includes a new form of locomotion on four legs. In this locomotion planner for Nao three categories of displacement are categorized that are frontal, lateral and on four legs; the locomotions are prioritized according to their speed of movement and the transition points between the different modalities are determined.

With the aforementioned characteristics presents a new planner for NAO in simulation and for several different scenarios. With this new locomotion planner NAO's navigation capabilities are expanded in environments where it uses the four-legged locomotion mode, as illustrated in Figure 1.

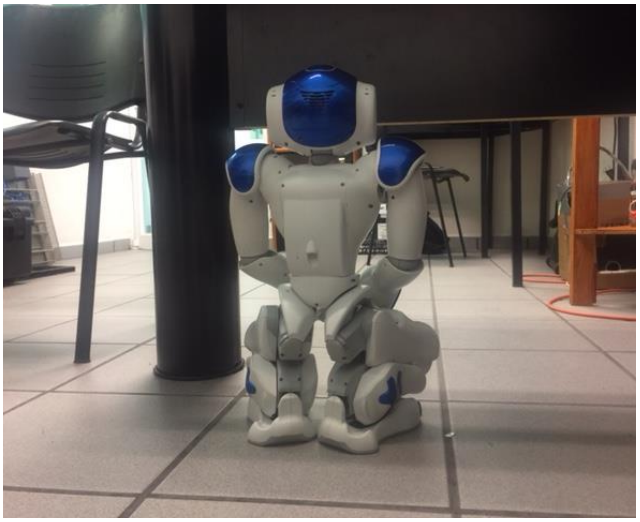


Figure 1 This image shows a case where the NAO robot needs to move to the other side of the desktop. However it is obstructed by a chair, so it is not possible to move, the only possibility to move is four legs under the desk or chair.

The content of the article is presented as follows, the next section 2 presents a brief review of what is the movement planning, then describes the robot Nao and its modalities of locomotion in section 3. Then, in the Section 4 presents the collision detector used for the planner, later in section 5 the scheduler for the robot NAO is presented. The test scenarios and the results obtained are presented in section 6, then section 7 presents the conclusions and finally the references.

Movement Planning

The problem of movement planning consists of a set of valid states and a set of actions, determining an obstacle-free path that allows a robot to move from an initial state to an end state (LaValle, 2006) (LaValle Et al., 2001). To pose a problem of movement planning and solve it requires the following parts:

a) Modeling of the robot geometry consisting of the computational representation of the real robot with geometric primitives such as triangles, spheres, boxes, among others.

b) Modeling the movements of the robot or object (hereinafter referred to simply as a robot), which consists in defining the independent degrees of freedom of movement that will be used to change the state of the robot.

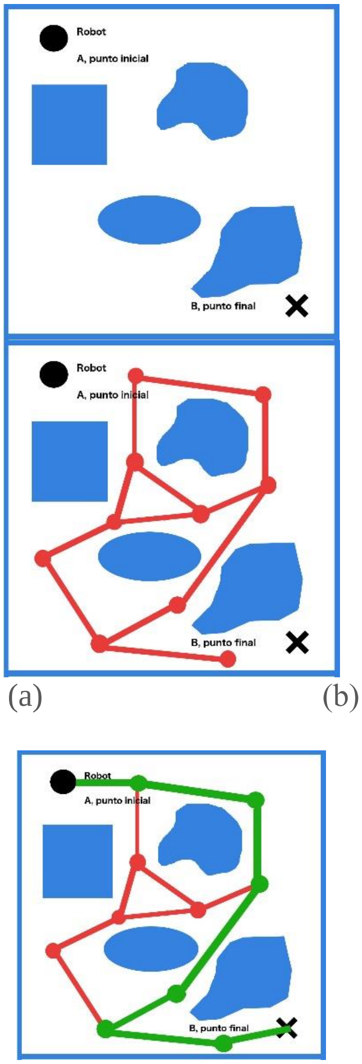
c) Modeling of the scenario and obstacles where the robot navigates, as a) refers to the computational representation of the scenario and objects present in it with which the robot interacts.

d) Collision detector, the collision detector is one of the most important parts of the planner is to determine if the representation of the robot in the current state is in collision with some element of the scenario.

e) Design of the strategy to create a navigation map generally based on a sampling scheme and graphs.

f) Strategy to determine if there is a solution for the robot to find a path from an initial state to the final state or, if applicable, a termination criterion.

In Figure 2, an example is shown to determine a route to go from point A to point B. The problem is to find an obstacle-free route with movements that the robot can perform.



(a) (b)

(c)

Figure 2 Example of motion planning a) the robot is presented as a point, the obstacles in blue, the initial position A, the final position B; B) it is presented the sampling of the states where there is no collision and the graph that is formed, c) to determine the route between the points A and B is solved connecting A and B with the graph.

Nao and his model of locomotion

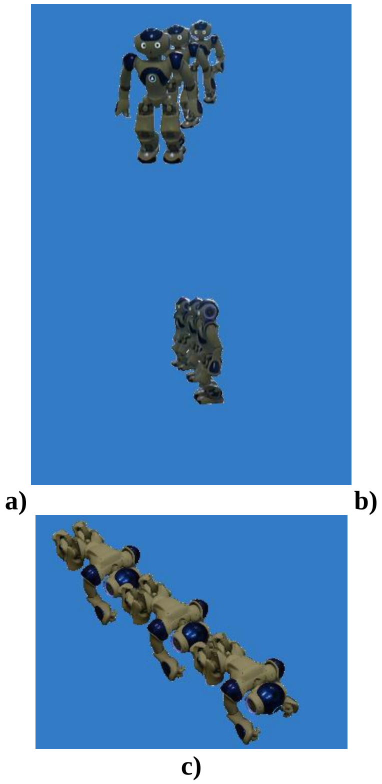
The robot Nao is a humanoid robot of 57.4 cm, 5.4 kg, with 25 degrees of freedom (dof) distributed as shown in Table 1.

Body part	**Degree of freedom or Board**
Head 2 dof	HeadYaw, HeadPitch
Left Arm 6 dof	LShoulderPitch, LShoulderRoll, LElbowYaw, LElbowRoll, LWristYaw, LHand
Right arm 6 dof	RShoulderPitch, RShoulderRoll, RElbowYaw, RElbowRoll, RWristYaw, RHand
Pelvis 1 dof	LHipYawPitch, RHipYawPitch * se controlan con un motor
Left leg 5 dof	LHipRoll, LHipPitch, LKneePitch, LAnklePitch, LAnkleRoll
Right leg 5 dof	LHipRoll, LHipPitch, LKneePitch, LAnklePitch, LAnkleRoll

Table 1 In this table the degrees of freedom of the robot Nao are presented in the different parts of the body or anthropomorphic structure.

The robot does not have a locomotion generator that is based on the position and orientation of the feet for the steps to be performed, then the generator calculates the trajectory of the joints (dof) keeping the robot balanced. If the robot is indicated the route that must follow the generator performs it, however this route must be previously planned so that the robot Nao does not move from an initial point to an end point.

Our proposal is to create a planner that includes Nao's locomotion generator and a four-legged modality. In particular, we consider the locomotion generation of the frontal and lateral robot together with the four-legged locomotion, see Figure 3. The four-legged locomotion integrated to the planner is the main contribution of this work. The planner considers that objects are not in motion, which in real scenarios this usually does not occur. However, this planner is the first one that arises in the Institute to begin to develop algorithms and methods for the future.


a) b)

c)

Figure 3 In this figure the three modalities of locomotion of the robot are shown: a) frontal, b) lateral and c) four legs.

A geometric tool to represent physically objects are Oriented Bounding Box (OBB), in our case the OBB were used to represent the robot. Therefore, OBBs have three degrees of freedom two for position and one for orientation, see Figure 4.

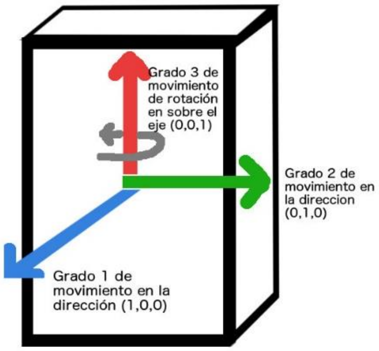


Figure 4 This figure shows the three degrees of freedom of the OBB used to model the robot Nao, in this OBB the robot can be wrapped and perform locomotion.

The OBB were used to represent geometrically the three modalities of locomotion. The OBB shown in Figure 5 are the minimum boxes where the Nao body can be wrapped in each of the movement modalities, according to the dimensions of Table 2. Therefore, the robot geometrically is modeled by three OBB: 1) OBBf representing frontal displacement, 2) OBBl lateral displacement and 3) OBBcp four-legged displacement.

OBB	**Dimensions**
Frontal	Height:55cm Width:39cm Depth:26cm
Side	Height:55cm Width:26cm Depth: 39cm
On four legs	Height:24cm Width:39cm Depth: 42cm

Table 2 This table shows the degrees of freedom of the robot Nao in the different parts of the body or anthropomorphic structure.

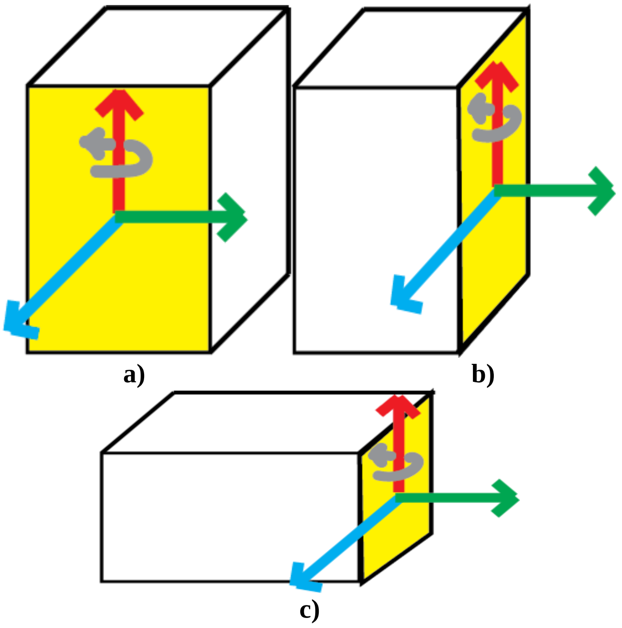


Figure 5 OBB that envelop the robot in each of the modalities of locomotion. In the illuminated part in yellow the direction of movement is shown, in addition the three degrees of freedom of each OBB are shown: a) frontal, b) lateral, c) on four legs.

OOBB Geometry Collision Detector

The collision detector is one of the most important components for a trajectory planner. In general, there are different methods to detect collision the most accurate, but with a lot of computational load, are based on verifying that all primitives between two geometries do not intersect. Others try to simplify the robot to geometric entities that involve large regions of the robot, using Axis-aligned Bounding Boxes (AABB), Oriented Bounding Box (OBB), spheres, cylinders or Combinations of these, (Stase et al., 2008), (Kanehiro et al., 2008), (Stolpner et al., 2012). The geometry of the robot is not shown in Table 3 which contains about 110 000 geometric primitives, in Figure 5 the robot is shown in the form of primitives. If geometries are used close to the real objects for the detection of collisions it is translated in computational time which for our case is not very convenient, since the presented planner is proposed to be used in line in interior environments.

Geometric primitives	**Cantidad**
points	52 158
Triangles	74 893
Squares	40 390

Table 3 Number of points and geometric primitives that make up the robot Nao.

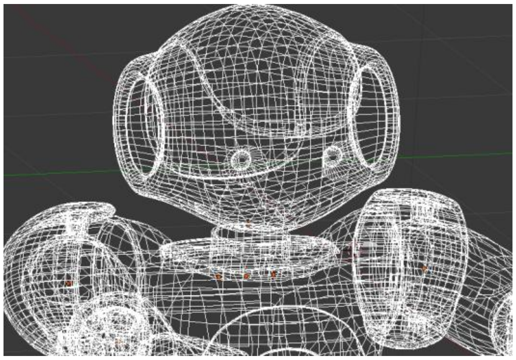


Figure 6 Exact geometric model of a section of the robot Nao showing the triangular and square primitives. When exact geometries are used to determine collision, each primitive of an object is compared to those that make up the other, this is computationally expensive.

To reduce the computational load we model the environment and robots as OBB which is a good approximation for us, that we look for the robot to have a relatively large tolerance. For collision detection between two OBBs, a method called a separator axis is used, which consists of projecting the vector between the centers T and the radii of the two objects rA and rB on an axis, see Figure 7. The OBB Are separated if Equation 1 is satisfied.

$$|T \cdot L| > r_A + r_B \qquad (1)$$

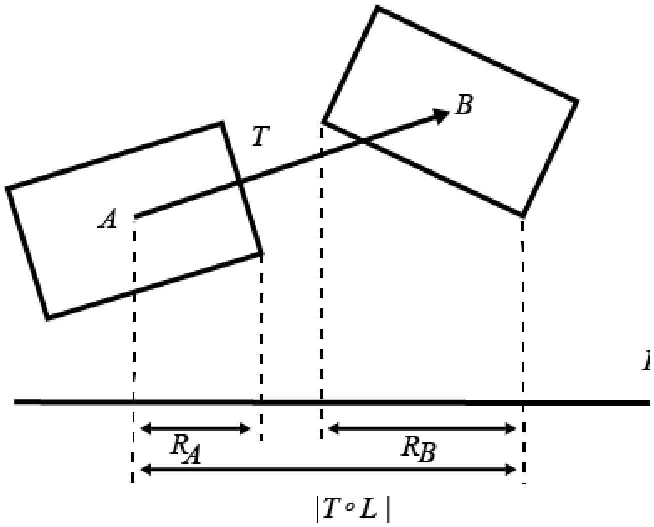


Figure 7 This figure shows the parameters involved in to test if a face of an OBB are separated.

For the detection of collision between two OBBs it is required to calculate 15 axes separators only, (Ericson, 2004), so compared to the approximately 110 000 primitives of the geometric model is a large reduction.

Locomotion planner for robot Nao

This section outlines the locomotion planner that includes the three modalities: front, side and four legs. Assuming that the scenario and the robot is modeled by OBBs, the steps for the planner are as follows:

a) Use a random posture generation method that includes position and orientation (x, y, θ□). In particular, we use a random function with a constant probability function.

b) Create a set of vertices V = {v1, v2, θ...}, where each vertex represents a pose and locomotion-free locomotion modalities, (xi, yi, □θi, F, L, CP) that do not Is in collision where F, L and CP correspond to the frontal, lateral and four legs that are satisfied. They take binary values F, L and CP.

c) With the set of vertices, the ones that are close to each other are searched to form edges, thus creating a graph G = {V, E}, where V is the set of vertices of b) and E is the set of edges. To create edges a method was used that finds the nearest neighbors. Then, to verify that the edge is valid this is followed by checking that it is not in collision with the objects of the stage, for this a scrolling step is used.

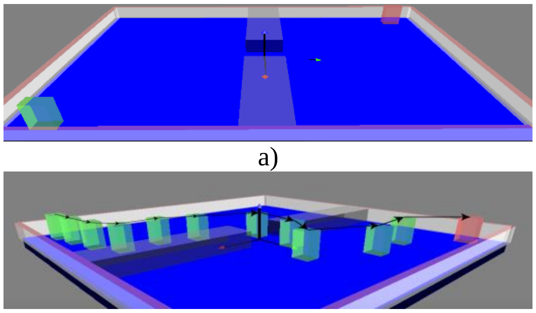
d) Once the graph created, given a slogan, that is, an initial posture and a final posture, it is necessary to look for a route that connects the two postures. For this, first the initial and final postures are connected to their closest vertex and then the graph is explored to find the route between the two vertices using the classic algorithms of graphs. Here, one of the modifications is prioritized to choose the vertex that has the modality of frontal locomotion, then Lateral and finally to four legs.

e) It verifies the search result that can be successful or fails. In the case of being successful a smoothing in the path is made so that it seems more realistic, in case of failure one can proceed to create more vertices and edges and repeat d) and e) or simply report a failure in determining a route.

Test scenarios and discussion of results

This section presents the test scenarios and the results obtained for three scenarios that illustrate the cases for which the planner is designed. The implementation was done in C ++, using OpenGL 2.0 and Boost Graph Library on a MacBook Pro computer with 2.4 GHz Core i5 processor without optimizing code for parallel processing.

In the first scenario, the frontal mode is used only to solve the problem, Figure 8 shows the scenario and the solution applying the scheduler. For this solution only 100 vertices were created, to achieve these vertices those that were close to each other were eliminated. Then, the graph was limited to creating 300 edges, ensuring that the two parts of the scenario are connected. This was done to not have a very large graph and that the search times were fast, in general it was determined that it lasts approximately 0.6 ms in the search.

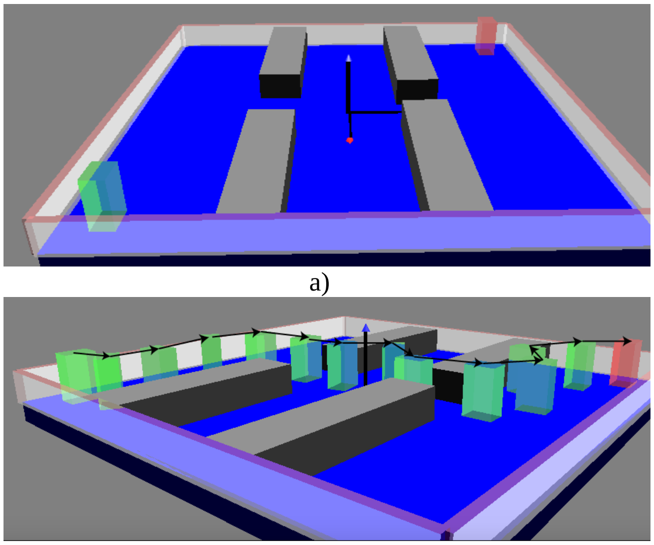


a)

b)

Figure 8 This figure shows the scenario where the setpoint of moving from the green start point to the red destination point is displayed, an obstacle is presented in the center of the stage. In b) the solution of our method is shown, only some parts of the route are shown.

In scenario two there are two broad and one narrower passages, see Figure 9. To solve this problem, it is required that in the second passage the mode of lateral locomotion is used, although using the frontal locomotion can cross the second passage Very tightly, this is not used since in many of the postures generated are in collision but are not in lateral locomotion. The solution of this problem we use 200 vertices and 400 edges.


a)

b)

Figure 9 This figure shows a) the scenario that consists of two passages and shows the setpoint that is the position of the OBB in red. In b) the solution of our method is shown, only some parts of the route are shown.

Finally, in the third scenario two obstacles are presented, one with frontal locomotion and the other that to cross it, it is necessary to use the modality on all fours since it is impossible to use the other modalities to pass through the second passage, see Figure 10.

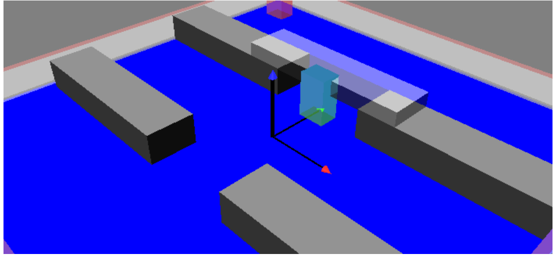


Figure 10 OBB of the robot will always be in collision using lateral and frontal modalities in the second passage.

The solution found by our method for the third scenario is presented in Figure 11, for this solution we also use 200 vertices and 400 edges.

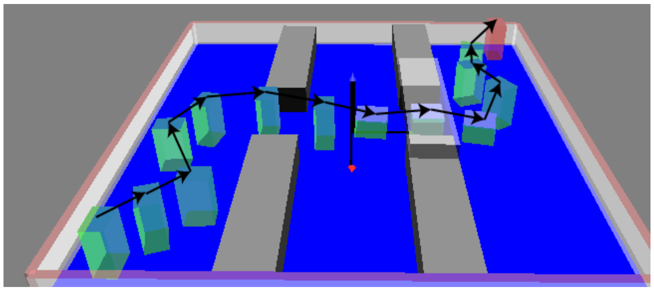


Figure 11 Part of the route for stage 3 is shown in this figure, it can be seen that to pass through the second passage it was necessary to use four-legged locomotion.

In general, the most difficult part to solve locomotion planning instructions is the construction of graph. With the paths found by the algorithm these still have to be processed so that the robot can perform them, since the temporal variable must be added. In addition, in the execution the robot has an important sliding and sliding in the feet, here important work for the execution of trajectories with more exactitude is required.

For static real scenarios it is only necessary to have a good representation of the obstacles using OBB at different scales and apply the scheduler presented here. With some modifications this planner can also be used to plan movement on manipulator robots. In the case of scenarios with moving objects, other types of planners are necessary, but this work is a starting point to create this kind of planners in the future.

Another very important problem is when you do not know the geometry of the scenario so the robot must create it and at the same time planning. This problem in mobile robotics is known as SLAM, however for humanoid robots it is a more complicated problem because the geometry must have a very high accuracy.

Conclusions

The planner shown in this paper presents in simulation three cases that illustrate the application about situations that may arise in reality. In particular, the scenario where the standing robot cannot cross the passage the planner determines a route where he uses locomotion on all fours.

This scheduler can be used in spaces where scenarios are known, modeled with OBBs and there are no mobile obstacles; which in reality is not very common reason why to develop planners that include obstacles in movement is an area of opportunity.

References

World Robotics Report 2016. (2016). Obtenido de http://www.ifr.org/: http://www.ifr.org/news/ifr-press-release/world-robotics-report-2016-832/

Kajita, S., Kanehiro, F., Kaneko K., Fujiwara, K., Harada, K., Yokoi, K. & Hirukawa, H. (2003). Biped walking pattern generation by using preview control of zero-moment point. IEEE International Conference on Robotics and Automation, 2003. Proceedings ICRA'03.

Masato, H. & Kenichi, O. (2007). Honda humanoid robots development. Philosophical Transactions of the Royal Society A: Mathematical, Physical and Engineering Sciences, Volumen (365), issue 1850,11-19.

Ill-Woo, P., Jung-Yup, K., Jungho, L. & Jun-Ho O. (2006). Online Free Walking Trajectory Generation for Biped Humanoid Robot KHR-3 (HUBO). Proceedings IEEE International Conference on Robotics & Automation, May, 2006,1231 - 1236.

Hauser, K., Bretl, T., Latombe, J.C., Harada, K. & Wilcox, B. (2008). Motion planning for legged robots on varied terrain. International Journal of Robotics Research.

LaValle, S. M. (2006). Planning Algorithms. Cambridge University Press.

LaValle, Steven M., Kuffner Jr. & James J. (2001). Randomized Kinodynamic Planning. The International Journal of Robotics Research.

Ericson, C. (2004). Real-Time Collision Detection. CRC Press, Inc. Boca Raton, FL, USA.

Stasse, O., Escande, A., Mansard, N., Miossec, S., Evrard, P. & Kheddar, A. (2008). Real-Time (Self)-Collision Avoidance Task on a HRP-2 Humanoid Robot. Proceedings of IEEE International Conference on Robotics and Automation · May 2008.

Kanehiro, F., Lamiraux, F., Kanoun, O., Yoshida, E. & Laumond J.-P. (2008). A Local Collision Avoidance Method for Non-strictly Convex Polyhedra. Proceedings of Robotics: Science and Systems IV.

Stolpner, S., Kry, P. & Siddiqi, K. (2012). Medial Spheres for Shape Approximation. IEEE Transations on Pattern Analysis and Machine Intelligence.

Instructions for authors

A. Submission of papers to the areas of analysis and modeling problems of the:

- Image and Signal Processing
- Control
- Digital system
- Optimization
- Artificial Intelligence
- Fuzzy Logic
- Mathematical Modelling
- Computational Mathematics
- Computer Science

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-Print text in Times New Roman #12 (shares-Bold) and italic (subtitles-Bold) # 12 (text) and #9 (in quotes foot notes), justified in Word format. With margins 2 cm by 2 cm left-right and 2 cm by 2 cm Top-Bottom. With 2-column format.

-Use Calibre Math typography (in equations), with subsequent numbering and alignment right: Example;

$$\partial \rightarrow \frac{\partial y}{z} = \frac{1}{2} \tag{1}$$

-Start with an introduction that explains the issue and end with a concluding section.

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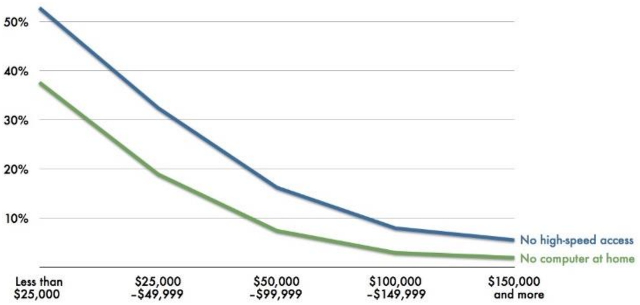

Graphic 1 Poor people have less access to high-speed internet and computers at home

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