Team Description Paper - EDROM

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***Abstract*—This TDP (Team Description Paper) is responsible to show the specific system of the robots of SEK's category, named Vera and Lucia, that UFU (Universidade Federal de Uberlândia)'s group named EDROM (Equipe de Desenvolvimento em Robótica Móvel) constructed.**

I. Introduction

THE project was constructed using *LEGO*'s bricks from the *NXT Mindstorm* kit. The kit has many types of bricks with different shapes, servomotors and sensors that are controlled by a PLC and energized with batteries of 1,5 volts. To make each robot was necessary 150 bricks including the PLC, engines and sensors.

The construction of the project was divided in 6 stages: 1) Looking for references that could help, 2) Making a *Brainstorm*, 3) Building the model in software, 4) Building the robot, 5) Starts the programming in the software for the specific kit, 6) Tests and optimization of the robots.

It's easy to work with the *Mindstorm Nxt*'s kit because of the bricks has many shapes and the easy-knowledge of the programming's software, but like any project it requires a lot of tests and caution with the engines and sensors tolerance.

Factors like light, sound and color of the ambient gives direct impacts in the mechanism's actuation, causing errors in receiving commands and direct actions like make a curve or stop the action of the robots.

The caution with size limit and errors with the tolerance of engines and sensors limited the accuracy of the robots, inciting new ideas to be formed to make the problem to be solved correctly.

The goal of IEEE SEK (Standard Education Kits) is develop two cooperative robots that must repair of the pipeline, besides the construction of an alternative pipeline in order to reduce the time of interruption in the flow of oil.

Manuscript received August 23, 2010. This work was supported in part by the FEMEC (UFU) and has financial support from FAPEMIG.

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II. Stages of the Project

A. Stage 1 – Looking for references

The first stage was done by researching materials about how best to use the *NXT MINDSTORM* kit and the explanations of how to use the programming software [1-9].

Finding the books and materials that has a good explanation about the engine's strength, way of use the sensors and its respective capacity and tolerance, was possible to continue to the next step.

B. Stage 2 – Brainstorm

With the necessary data in hands, the stage 2 starts with a group's reunion where ever group's integrant gives suggestions and show all ideas to solve the competition's problem spending the minimum time possible and using the kits that is dispose.

C. Stage 3 – Modeling in the Lego Design software

When the idea project's structure came up is time to make a prototype model in the computer. The best way found to do it is using the software called *Lego Design* projected by *LEGO* enterprise. This software has a tool that helps the user to build the robot guiding step to step, Fig. 1.

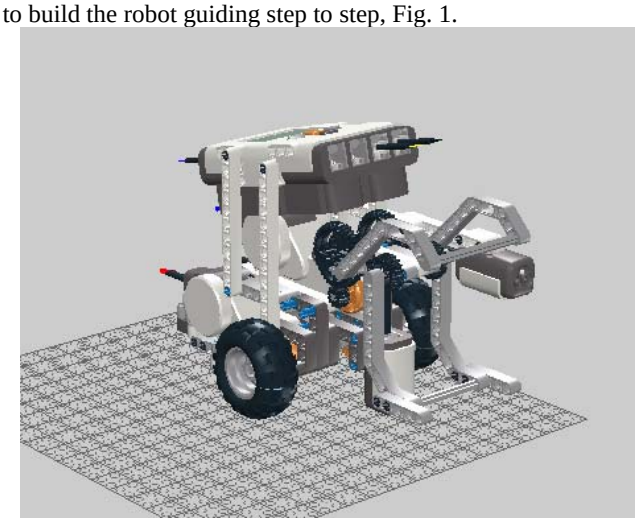

Fig. 1. The design robot made in the *Lego Design* software.

Using the *Solid Works* software was possible to make the virtual arena of the competition, Fig. 2. In this step was performed the optimization of the best path for the repair of oil lines.

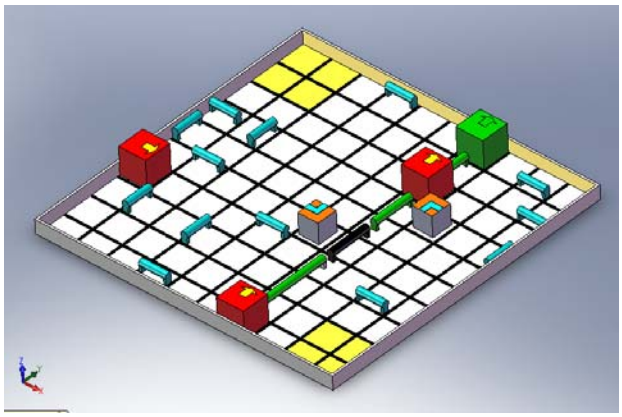

Fig. 2. The virtual arena made with the *Solid Works* software

D. Stage 4 – Building the robot

In the building stage the project starts to gain form. The first step is to allocate the bricks like the design software shows, then allocate the PLC and sensors. It is possible to make a real arena equal to the competition one to give test stage more accuracy, Fig. 7.

E. Stage 5 - Programming

To start the programming stage it's necessary a data review, that can be helped by the *help tool* in the software. There is found a great number of information and tips that will help the programmer to succeed in his objective. The major limitation of the use the LEGO NXT Mindstorm kit is your programming and limited memory capacity.

The great obstacle in programming is the errors in engine and sensor's precision, and then the sensors must be allocated in a place of strategy that can diminish the errors.

F. Stage 6 – Tests and optimizes

The last stage is where the robot is tested and optimized. If in the test was found an error, the robot can be modified easily with the design software support. The trouble in modify the structure of the robot is that the program has to be all modified too, and to ever step of the strategy has to be tested again, like making the curves and the local of the sensors.

III. THE PRINCIPAL ASPECTS OF THE ROBOTS

The EDROM's project consists in 2 robots of same aspects, named Vera and Lucia, built with 2 wheels and a sphere system that gives an appearance of a tricycle. Each robot is capable of lift up the pipes using a claw and a system that just needs 1 servomotor. A count-lines system was created improving the precision of the engines that rotates the robot wheels and gives a best precision in making curves. To recognize the pipes it uses a color sensor that can be changed to a touch sensor, but the first has a best actuation, Fig. 8.

A. Count-lines system

The Count-lines system is composed of a color sensor pointed to the floor in the center of the robot that can be changed by a light sensor, it differs the white floor from the black tape adding one number when the black color is found. When the counting gets to the number desired the robot make the presumed action, Fig. 3.

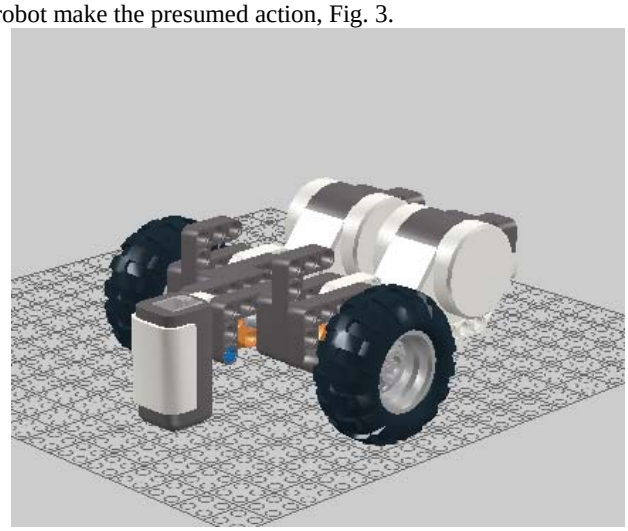

Fig.3. The forward wheels with the respective servo-engines and color sensor.

B. Sphere system

The sphere system looks like a spherical joint, locking a ball in the back of the robots, giving the minimum contact with the floor and improving the mechanism accuracy, Fig. 4.

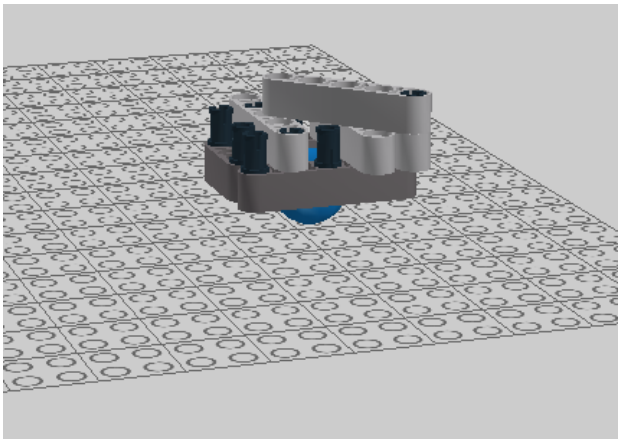

Fig.4. The third wheel system made in Lego Design software

C. Recognizing the pipes

It uses a sensor close to the claw. The robots take the pipes when the sensor is activated to a distance more precisely, Fig. 5.

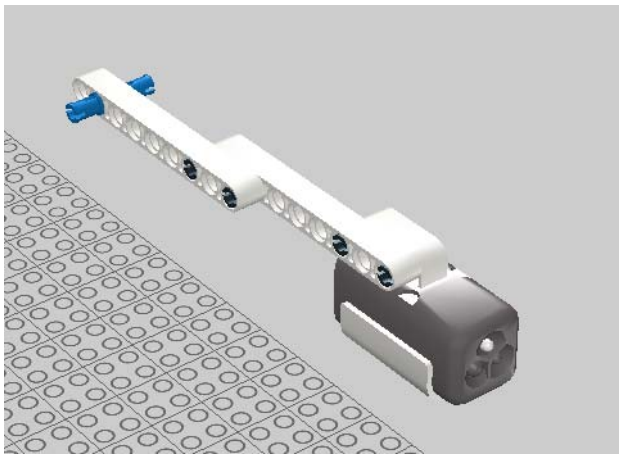

Fig.5. The sensor responsible for recognize the pipes

D. The claw system

The claw is constructed with a system that uses many gears of different sizes. When the claw takes the pipes, it lifts them and can move until the destine point, Fig. 6.

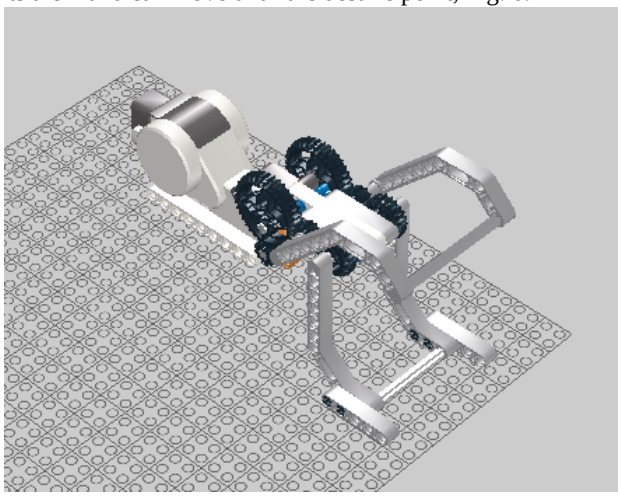

Fig.6. The claw system made in Lego Design Software

IV. Conclusion

The project and construction of the robots was a good challenge because the objective is to repair a system of oil's distribution with the fastest way possible and with a certain accuracy to ensure that the flow of oil doesn't harm the environment and to restore supply. To ensure the accuracy of the robot, a system of a sphere was developed and it looks like a spherical joint that locks a ball in the back of the robots, giving the minimum contact with the floor and improving the mechanism accuracy, and also grants stability to the robot's movement.

The claw was built to work synergetic with the color sensor and the transmission system of the claw was developed to work according to motor's rotation and direction.

Appendix

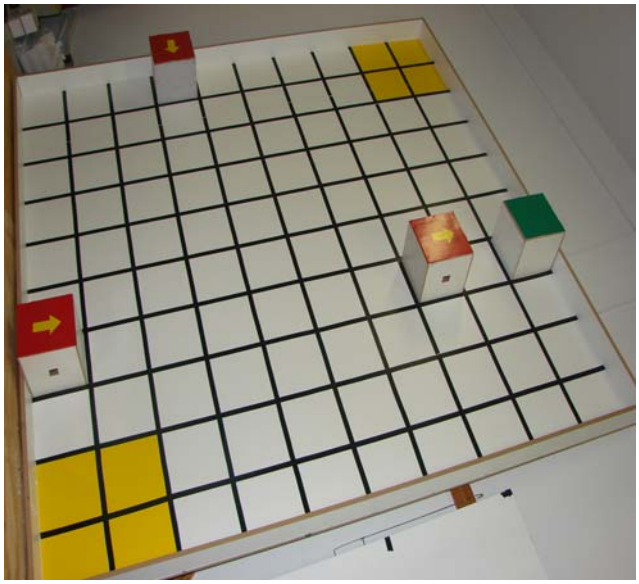

Fig.7. The constructed arena for practice

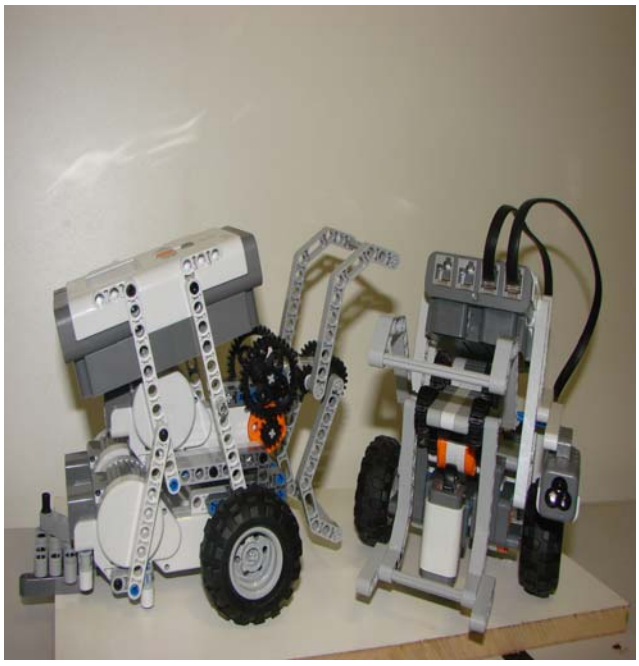

Fig.8. The two robots ready for the competition.

Acknowledgment

The authors are thankful to Federal University of Uberlândia (UFU) and Fundação de Amparo à Pesquisa do Estado de Minas Gerais (FAPEMIG) for the partial financing support of this SEK competition and research work.

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