LARC 2010 - IEEE SEK Category - CP Team Description Paper

Manuel Almuna, Tomás Hernández, Joao López and Cristian Morales
{malmuna, thernand, jslopez, cmorales}@csrg.inf.utfsm.cl

***Abstract*— The following document describes the work done by the *CP* team in the design and programming of robots in order to achieve the goal proposed in the IEEE Standard Educational Kits category 2010.**

I. INTRODUCTION

This document describes the methodology used by the *CP* team to participate on the IEEE Standard Educational Kits (SEK) category, part of the Latin American Robotics Competition (LARC) 2010 [1].

The team is composed of four Chilean Computer Science Engineering students from Universidad Técnica Federico Santa María, members of the Computer Systems Research Group (CSRG) [2]. Team members since 2008 has been constantly involved in robotics instances with legos as Chilean robotics competition and software development fairs demostrations.

For the construction of the robots two Lego Mindstorms NXT kits were used, with the firmware version 1.29 .The programming language used is NXC (Not eXactly C) [3] and the chosen integrated development environment it was Bricx Command Center v3.3 [4].

II. GOAL

The arena simulates an area with a leaking pipe and tubes around. The challenge is to deploy two robots capable of working collaboratively to build an alternative pipeline, in order to reduce the time of interruption in the flow of oil [5].

III. ENVIRONMENT CONSIDERATIONS

The main guide for the robot on the scenario it consists on a compass sensor which will allow to move it accurately through the lines and make precise turns. As the compass sensor uses magnetic fields to know which direction points, we will have to avoid any surrounding interferences such as cellphones, laptops or any other device who can dull the correct sensor measures.

Considering that each robot uses light sensors to move around the arena and to realize its current position, the ambient light is an important factor to be aware of among the environment considerations. Therefore, the programming team has included a calibration process to mitigate the problems of this environment condition.

Another important aspect to consider is the coefficient of friction of the platform and the weight of the objects that will be pushed through the arena, since according to this information the power of the engines must be defined.

Also, the obstacles present in the arena must be considered in order establish efficient routes without problems.

This work was supported by Departamento de Informática, PIE-A and Computer Systems Research Group from Universidad Técnica Federico Santa María, Valparaíso, Chile

IV. PROCEDURES

A. Robot structure

To achieve the challenge goal, two identical robots were designed. Each robot is composed of one NXT intelligent brick that will allow us to control:

- 2 Servo motors to move the robot around the field.
- 1 Compass sensor to know in which direction the robot points, allowing navigation.
- 1 Light sensor to detect the crossed lines while moving on the field. These will be used to determinate the current position.
- 1 Ultrasonic sensor to determinate the proximity of a pipe that must be transported.
- 1 Light sensor on the back used to estimate when the robot is aside the fixed platform in order to activate/deactivate the valves. By the other hand this sensor will detect when a line is crossed while executing the task of moving the curve pipelines.
- 1 Servo motor to command an elevator that grabs, transports and releases the pipelines.

To avoid the leak of oil and to restore the normal flow after repair, a wood valve has to be switched on and off, to do that our robot has a brick wall in his back intended to press (meaning switch) the valve against the platform when it'd be necessary. This wall it'll serve to move the curves pipelines too; that is, when the robot need to move one of it, it will turn back and push the platform in the desirable direction with the help of a light sensor that will detect the limit line.

B. Robot Navigation

As the scenario has a static nature (that is, every actor will have an specific location) the programming routine that will allow the general navigation will not be decided *online*, instead it will be a *offline* fixed sequence of steps.

A critic issue on navigation its to know where the robot is at every moment, to do that we mixed two approaches:

- We want the robot to move straight forward on the arena inside the field quadrants, parallel to the grid lines, so we can assure that when the robot crosses a lines it's moving to his horizontal or vertical neighborhood and not to the diagonal one. Furthermore, we need the robot to do accurate turns, so the robot only moves

in horizontal or vertical directions. A compass sensor will be responsible of these tasks; at the beginning a calibration process will detect the arena lines direction using this as a reference direction so the robot can run parallel o perpendicular to the lines.

- We also need to know when the robot passes from one arena quadrant to another, to achieve that the robot uses two light sensor that detect when the robot crosses a line forward or backward.

With this information the robot will have a fairly good sense of space and it will be able to go to specific points on the arena.

Both robots will have the same structure and will be able to do the same tasks, such as transport a pipe, switch a valve or move a curve pipelines, those tasks are arranged and assigned in such a way that the robot minimizes the total amount of time and consequently the virtual money lost building the alternative pipeline that is the final goal.

C. Robots Coordination

The robots will be working at the same time in the field but with different objectives, therefore sometimes the robots path can crossed each other so it's necessary for them to know where each other is, in order to avoid any possible collision. In some cases the robot will communicate their current and destiny location to know if it's available and to reserve it so the other robot don't try to go to the same point. The communication will be performed through the inner *bluetooth* device of each robot.

V. CONCLUSIONS

Building a robot to solve an specific non trivial problem is a challenge goal that give us the opportunity to apply our engineering knowledge, proposing ideas and validating them in a real environment.

As computer sciences students the SEK category is the ideal scenario to show our capabilities, as we don't have an expert knowledge on electrical or electronic devices, and instead we can concentrate in the development of an efficient procedure and use of resources.

Finally the Latin American Robotics Competition it represents for us a huge opportunity to share knowledge, grow academically, make links with people interested in robotics and computing around the world and last but no least as a first team working experience abroad.

REFERENCES

[1] LARC 2010 - SEK Category, http://www.larc10.fei.edu.br/IEEESEK.htm
[2] Computer Systems Research Group (CSRG), Universidad Técnica Federico Santa María, http://csrg.inf.utfsm.cl
[3] Next Byte Codes (NBC) & Not eXactly C (NXC), http://bricxcc.sourceforge.net/nbc
[4] Bricx Command Center 3.3 http://bricxcc.sourceforge.net/
[5] LARC 2010 SEK Rules, http://www.larc10.fei.edu.br/LARC2010_SEK_v1INGLES.pdf