ENGINEERING PORTFOLIO

Andre G. C. Pacheco

Table of contents

Profile

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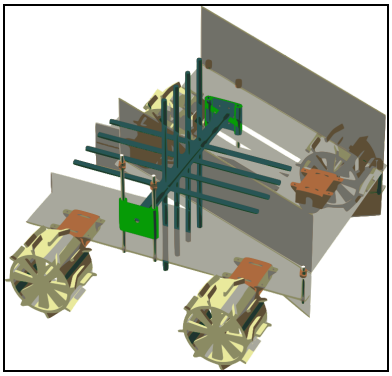
About this portfolio

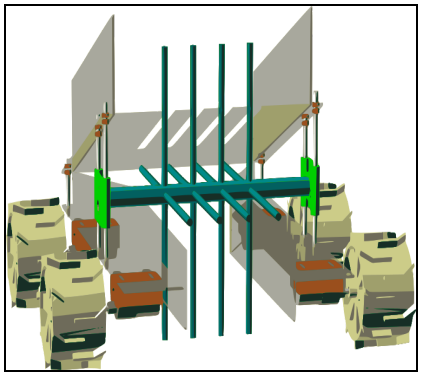
This portfolio aims to supplement my resume by presenting some selected projects I developed during my undergraduate studies. I believe that one of the most important things in any undergraduate is to participate in hands-on projects. As you will see, during my undergraduate in Computer Engineering, I got involved with different projects with different levels of knowledge. For each project, I provide a description, source codes, and videos. If you have any questions about any project, feel free to get in touch with me by e-mail.

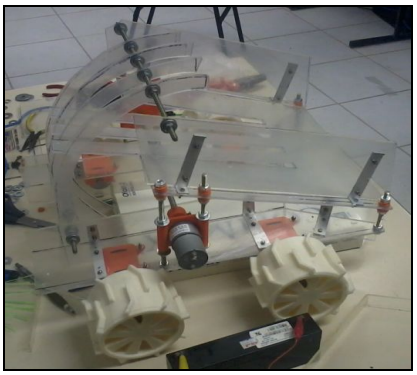
Beach cleaner robot

Overview

- A project developed to the 11th IEEE Latin American Robotics Competition (LARC) - Open category. Arequipa - Peru, 2013.
- It consists of an autonomous robot developed to collect solid garbage in a scenario that simulates a beach in a tiny touristic island.
- The robot was designed in a 3D software called OpenScad. Its physical structure is of acrylic and PLA filament, a thermoplastic used in 3D prints.

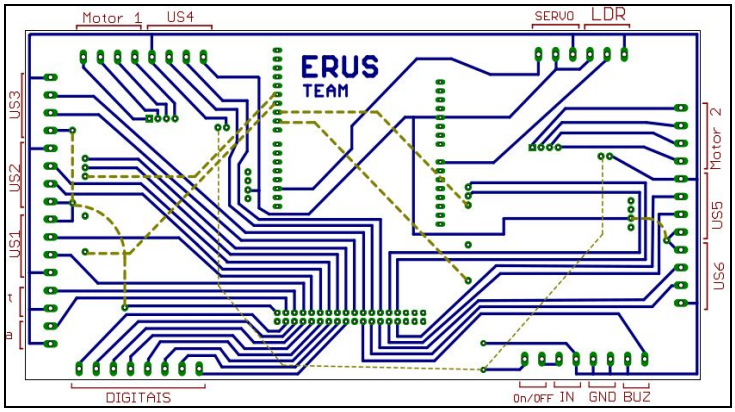


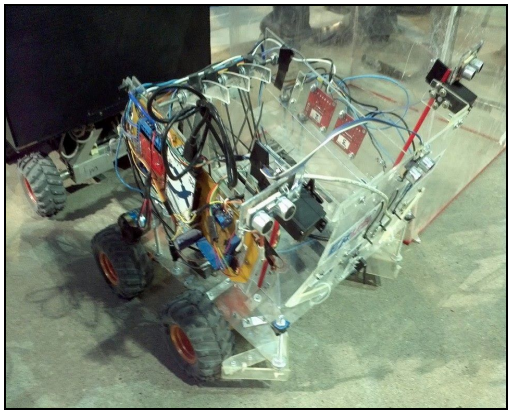




- The figures above show the robot's 3D model and the built robot.
- The figure on the left shows the simulated arena. The robot's goal is to collect the black cans, without touching the water, and throw them in the red garbage.

- The robot was controlled by an Android smartphone and an Arduino Mega ADK on board.
    - The computer vision processing was done on Android, which commands the Arduino
    - The Arduino controlled the motors and the ultrasonic and touch sensors
- All code was developed using C, C++, and Java.
- The PCB boards were developed using EAGLE.





- A curious situation happened before the competition. During the team's trip to Peru, the airplane company has lost our luggage with most robot structure parts.
    - The team rebuilt the robot 2 days before the competition started
- You may note in the image above that the robot is a little different than the projected one.
    - For example, the projected wheels were lost and the team bought new ones in a local market.

My contributions

- I led the team with 10 members that worked on this project for one year.
- The was divided into three sub-teams: electronic, structure, and coding teams.
- Beyond leading the team, I worked on the 3D modeling, coding the Arduino and the computer vision processing.

Results

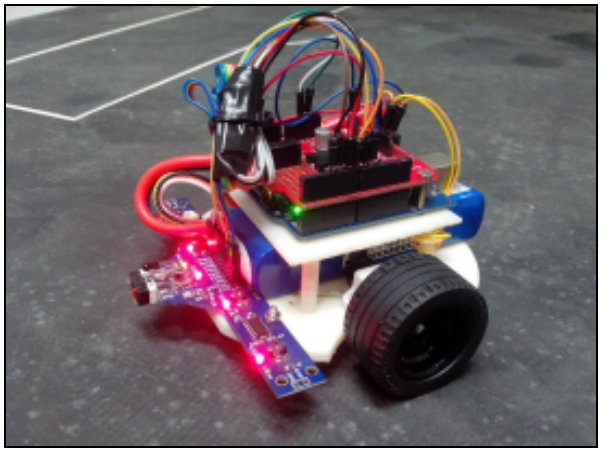
- The robot was able to solve the simulated problem successfully.
- My team got 2nd place out of 19 teams in the competition.
- The whole project is available on Github.
- The team description paper (TDP) is available in this link.
- You may see the robot's performance on YouTube.
- We also got famous in our city! Have a look at some interviews: Local News, G1 News.

Team pictures

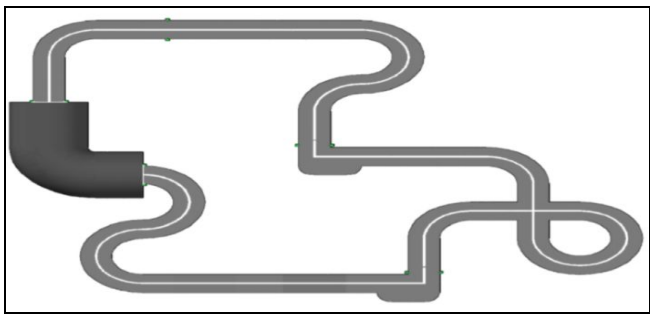
Line follower robot

Overview

- This Project was developed to the 3rd Robotics University Tournament (TUR) at the Federal University of Uberlândia (UFU) - Uberlândia, Brazil, 2013.
- It consists of an autonomous robot developed to compete in a robot race.
- The racetrack has a line, which the robot must follow, and some other challenges such as slopes, dark places, and crossroads.



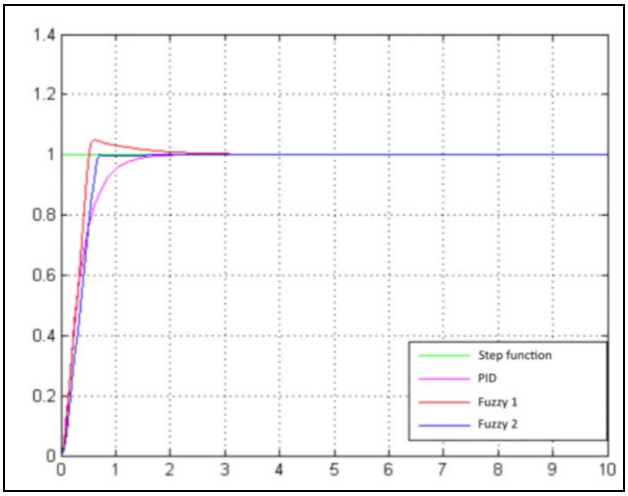
- The robot structure was projected on OpenScad and printed in a 3D printer.
- In order to follow the line, the robot's software used a PID controller based on 10 light sensors in a developed PCB board.
- All code was developed in C/C++ using an Arduino UNO board.



- The figure on the left illustrates the racetrack. As you can see, there are different challenges that the robot must overcome.
- You can watch the robot racing on the racetrack on YouTube.

My contributions

- I led a team with three members that worked on this project for six months.
- In particular, I designed the 3D model and coded the PID controller.
- Later, this project became my undergraduate thesis. In summary, these are the topics I worked on the thesis:
    - Modeling the whole system on MATLAB Simulink
    - Optimizing the PID with the Differential Evolution (DE) algorithm
    - Developing a Fuzzy controller
    - Comparing both controllers



- The graph on the left illustrates the response of the fuzzy and PID controllers to the step signal
- In the context of a line follower robot, the step sign simulates a 90º curve (see the video on YouTube).

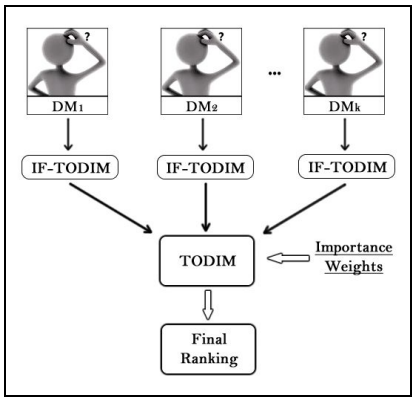
Results

- The robot was able to perform the whole racetrack in a competitive way.
- My team got 5th place out of 29 teams in the competition.
- The thesis results show that a fuzzy controller is viable to be used as a controller for a line follower robot.
- You can check the robot's performance on YouTube
- You can also have a look at these TV news about the competition.

Decision-making algorithms

Overview

- In this project, I worked with decision-making algorithms, such as TODIM and TOPSIS, and Fuzzy logic applied to an oil accident problem.
- It was my undergraduate research under supervision of Prof. Dr. Renato A. Krohling and scholarship from Fundação de Amparo à Pesquisa e Inovação do Espírito Santo (FAPES) - the Espírito Santo states' research agency
- We developed a new method called IF-TODIM, which is based on TODIM algorithm and Fuzzy Intuitionistic logic, that considers the data's uncertainty.
- The algorithm was developed using MATLAB.



- The figure on the left describes the algorithm's workflow.
    1. Each decision-maker assigns a score for a given criterion related to an alternative to solve the problem.
    2. Next, the IF-TODIM will consider the uncertainty for these scores and the importance of each criterion.
    3. Lastly, the algorithm outputs an alternatives' ranking to solve the problem.

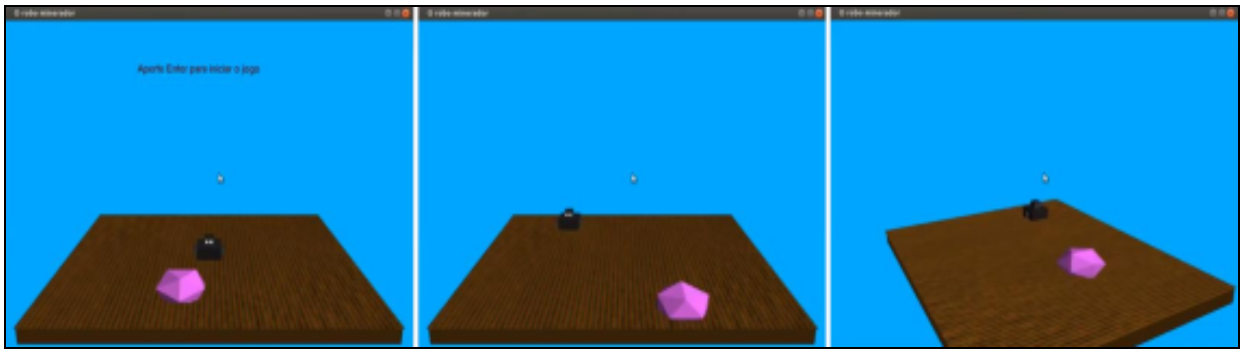
Results

- This project was awarded with *The best undergraduate research work* in engineering and exact sciences at the Federal University of Espírito Santo (out of 151 projects).
- We published this work on the Knowledge-Based Systems, an Elsevier Journal. You can access the work through this link.
- The code is available on Github.

OpenGL game

Overview

- This project is a simple game developed as an assignment of the Computer Graphics discipline at UFES in 2013.
- The game was developed in C/C++ using the OpenGL library.
- The game's goal is pretty simple:
    1. A purple diamond will show up on the screen in different places.
    2. The player needs to control a little robot to collect as many diamonds as possible in 60 sec.
    3. In the end, the player's score is shown on the screen



The game's screenshots

Results

- The simple game worked fine and the whole code is available on Github.
- You can check the "gameplay" on YouTube.

Music recommendation system

Overview

- This project is a fictitious music recommendation system developed as an assignment of the Web Semantic discipline at UFES in 2014.
- The system simulates a social network in which the user needs to sign up and provides information about the kind of music they like. Next, the system will recommend some bands and songs according to the user's answers.
- The system consumes data from Wikipedia in order to provide the recommendation.

- The system was coded using the Java EE platform along with the following frameworks:
  - Java Server Faces (JSF)
  - HTML and CSS
  - Primefaces
  - Facelets
  - Hibernate,
  - Java Persistence API (JPA)
  - MySQL
- To consume data from the web, I used SPARQL with apache JENA framework.

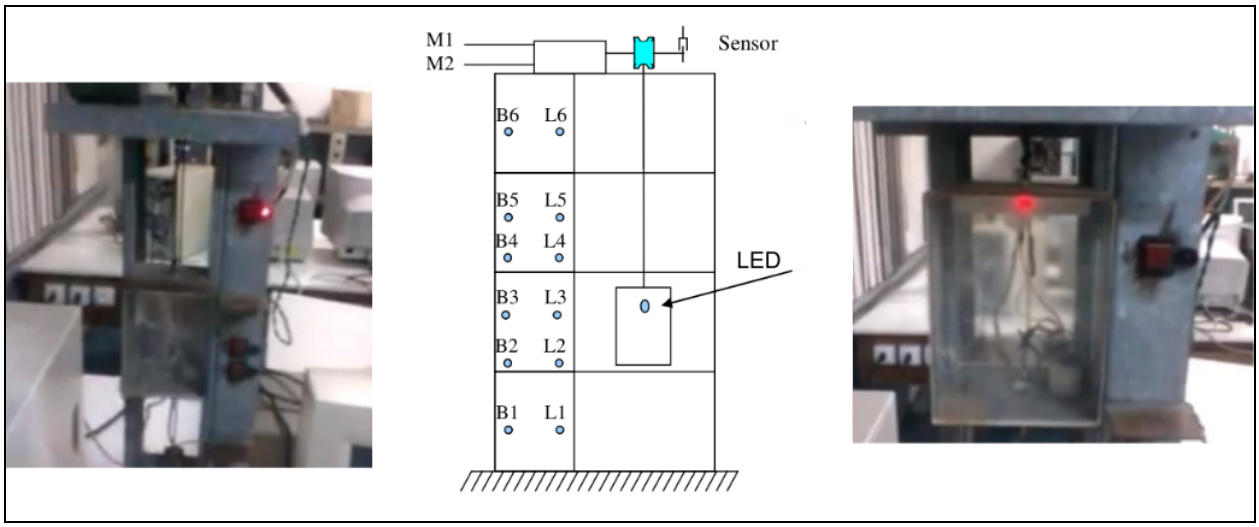
Results

- The system was able to make simple recommendations to users
- As it was so hard to find Apache JENA's tutorial on the internet, I created some youtube videos explaining the main conceptions in Brazilian Portuguese.
- The project's code is available on Github

Elevator control system

Overview

- This project consists of a code to control a schematic elevator developed as an assignment of the Embedded Systems discipline at UFES in 2012.
- The elevator was controlled by an Intel 8088 controller. Therefore, the language used in this project was Assembly.



My contributions

- The code was developed in partnership with a classmate.
  - It's worth noting that we didn't build the schematic elevator, only the code to control it.
- My main contribution was coding the graphic interface
  - It was a terminal interface that showed the elevator moving through the floors
  - Yes, it was in Assembly and it was tiresome since I needed to draw every single point on the screen.

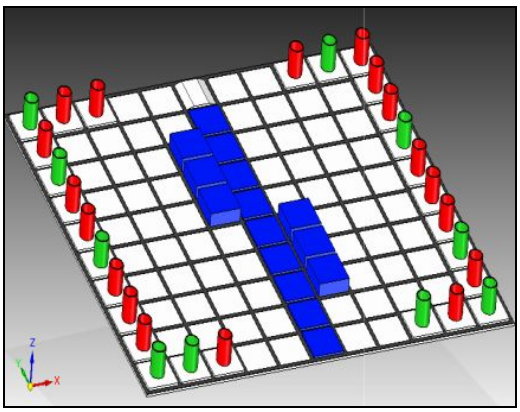
Results

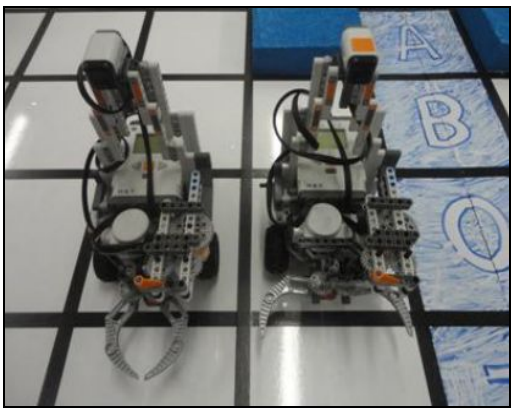
- The code controlled the elevator properly. Despite simple, the graphic interface was very useful to follow the elevator movement and debug the code.
- The code for this project is available on Github.

Dike construction robots

Overview

- This project was developed to the 10th IEEE Latin American Robotics Competitions (LARC), for the Standard Educational Kits (SEK) category - Bogotá, Colômbia, 2011.
- It consists of two autonomous robots working in cooperation in order to construct protector dikes to wrap a river in a simulated arena.
- The robots were developed using the Lego Mindstorms Robotic kit. Both robots were coded using a C-like language.
- The robots used a compass, light, and touch sensor. The communication between both robots was achieved using a Bluetooth protocol.





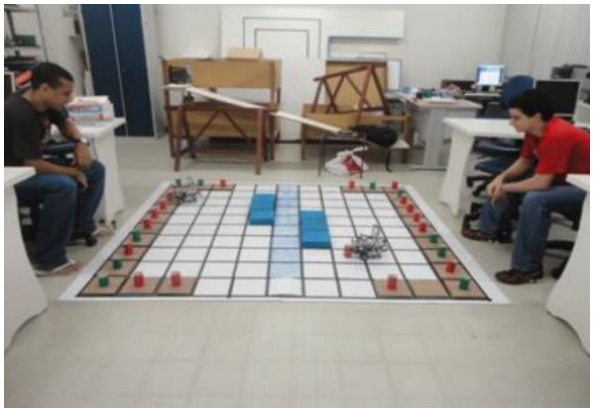
My contributions

- I was part of a team composed of four students that worked on this project for eight months.
- We worked equally in the following activities:
    - Building the robot using the gears, engines, and hardware available for the kit.

- Designing a solution to solve the problem and coding it for both robots.

Results

- The robots worked collaboratively to properly construct the dikes in the simulated arena.
- My team got 1st place out of 22 teams in the competition
- The code for this project is available on Github.

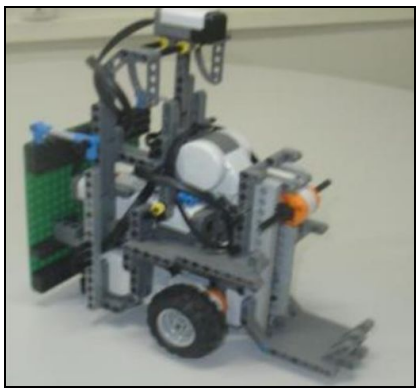
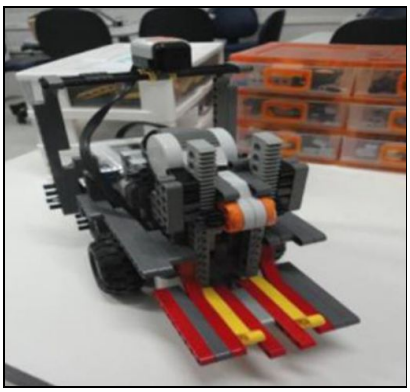
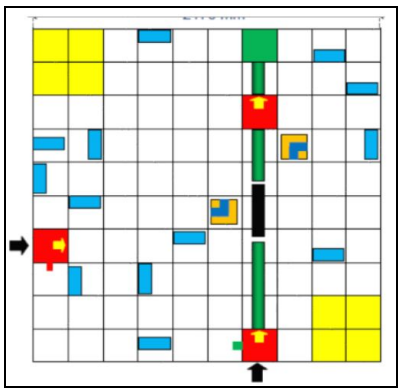


- You can check the robot's performance during the competition in the following videos:
  - Video YouTube 1
  - Video YouTube 2

Pipeline repair robots

Overview

- This project was developed to the 9th IEEE Latin American Robotics Competitions (LARC), for the Standard Educational Kits (SEK) category - São Paulo, Brazil, 2010.
- It consists of two autonomous robots working in cooperation in order to repair a leaking in a pipeline a simulated arena.
- The robots were developed using the Lego Mindstorms Robotic kit. Both robots were coded using a C-like language.
- The robots used a compass, light, and touch sensor. The communication between both robots was achieved using a Bluetooth protocol.

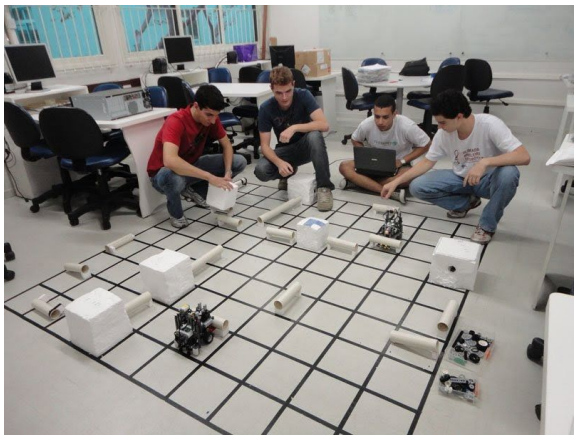
My contributions

- I was part of a team composed of four students that worked on this project for six months.
- We worked equally in the following activities:
    - Building the robot using the gears, engines, and hardware available for the kit.

- Designing a solution to solve the problem and coding it for both robots.

Results

- The robots worked collaboratively to reconstruct the pipeline successfully in the simulated arena.
- My team got 1st place out of 31 teams in the competition
- The code for this project is available on Github.



- You can check the robot's performance during the competition in the following videos:
  - Video YouTube 1
  - Video YouTube 2
- You can also watch some TV news about our project:
  - Globo Notícia News
  - G1 News
