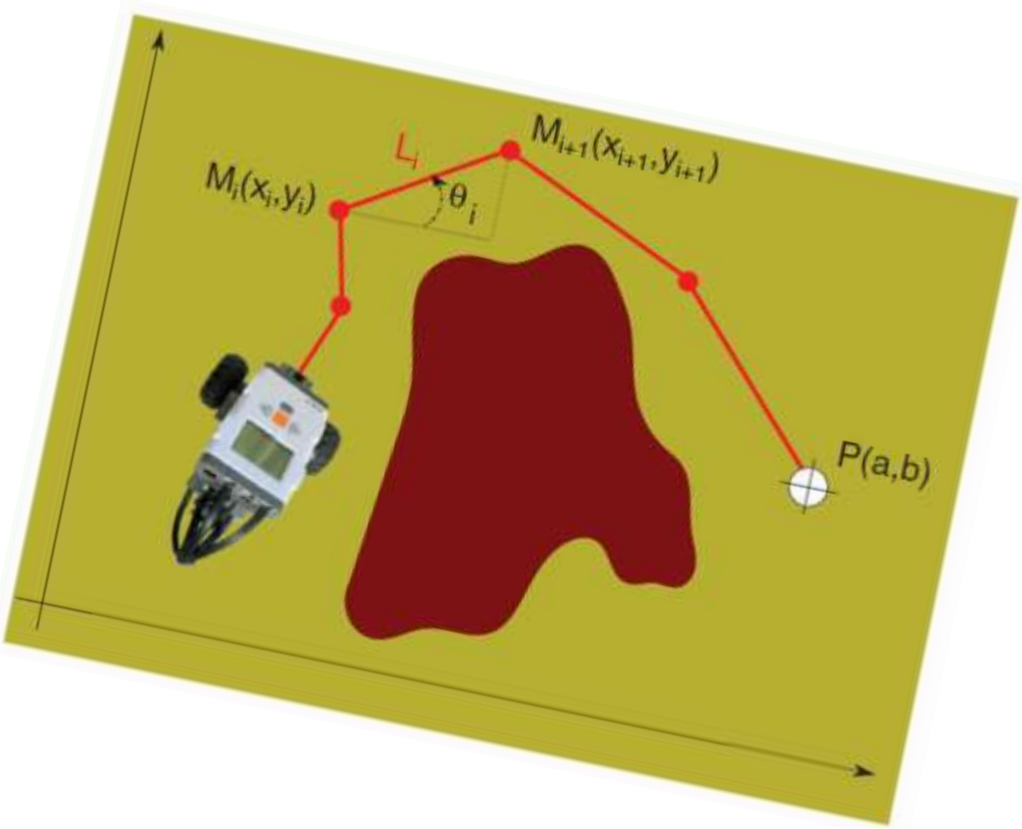
Young Robotics Explorers Using LabVIEW

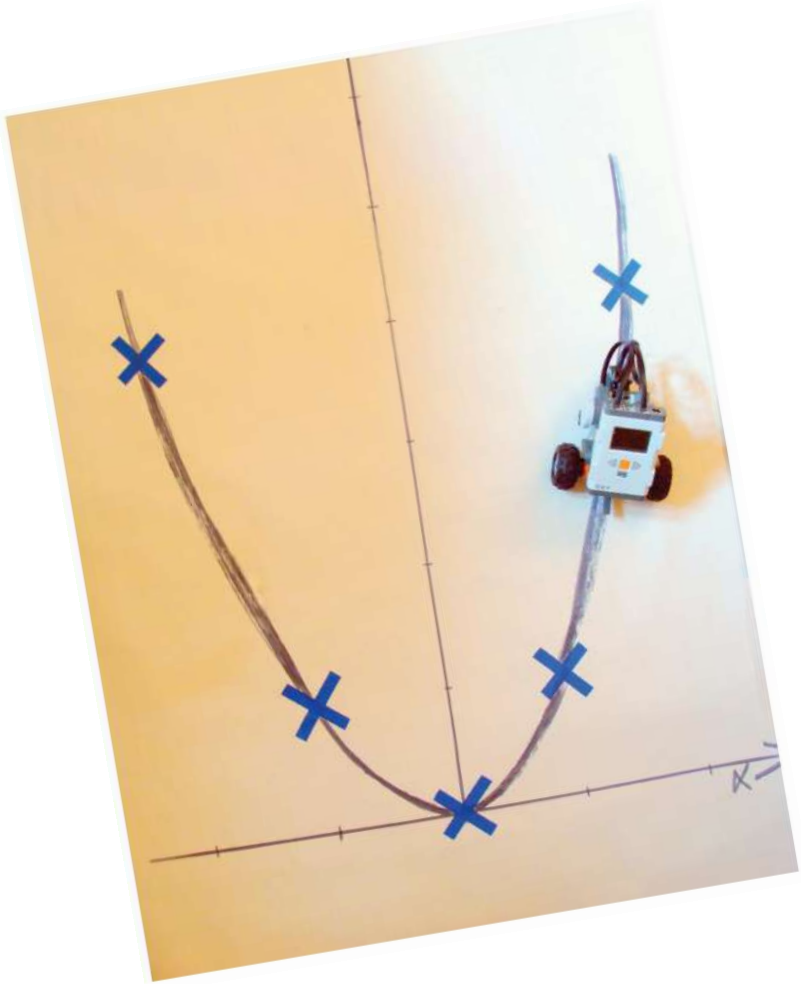
NI-Days Brussels, October 9th, 2012 15h15 – 16h00

Claude Baumann

This presentation will introduce the audience to some of the secrets deployed at the youth lab. Especially, you will hear about project-based learning and problem-solving using LEGO® robotics… and you will be challenged with some interesting robot problems, while seeing how adolescents solved these. For those, who can't wait until October 9th, here is a little brain-teaser: Design a robot that will be able to find the center of a duct-taped circle with radius 1.2 – 1.5m.

Challenges





NATIONAL INSTRUMENTS LabVIEW™

LEGO mindstorms

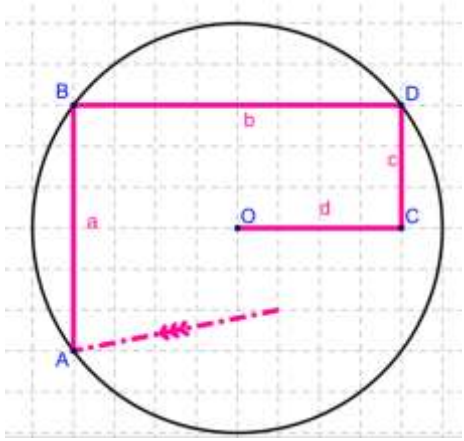
Challenge 1: Find the center of a circle.

Searching for the Center of a Circle

Therese C. **Biedl**, Masud **Hasan**, Joseph Douglas **Horton**, Alejandro **López-Ortiz**, Tomás **Vinar**:

CCCG 2002**, pp. 137-141.

**Proceedings of the 14th Canadian Conference on Computational Geometry, University of Lethbridge, Alberta, Canada, August 12-14, 2002


B
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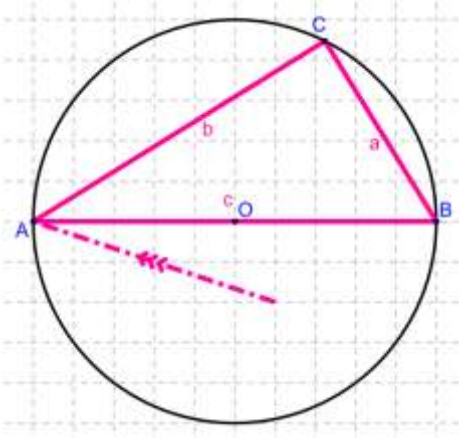
b
c
a
O
d
C
A


C
b
a
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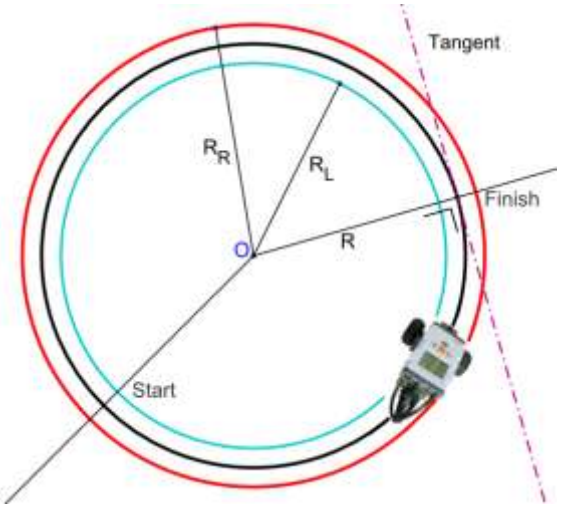
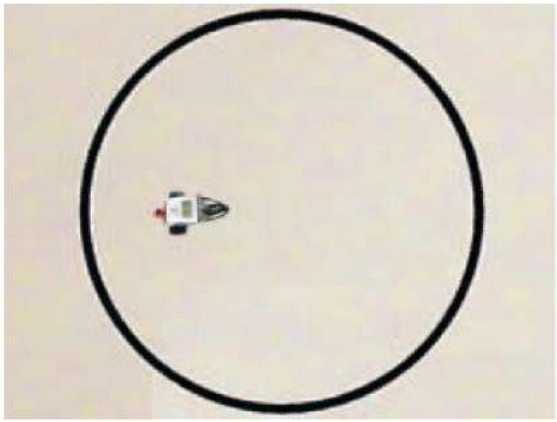
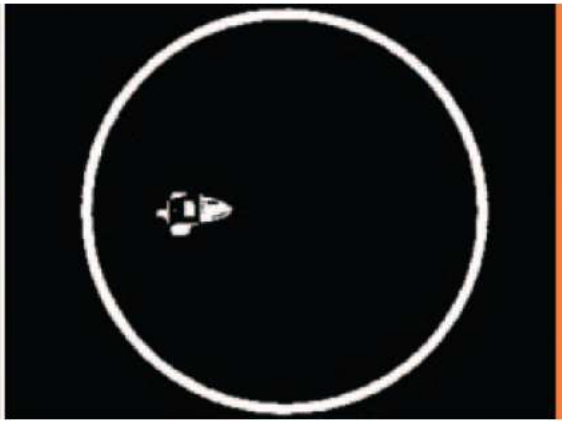
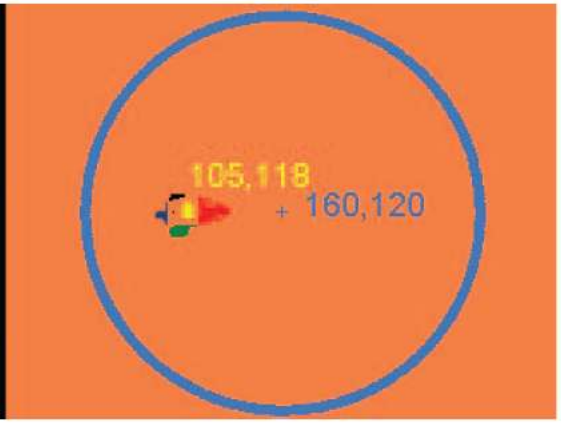
O
A
B

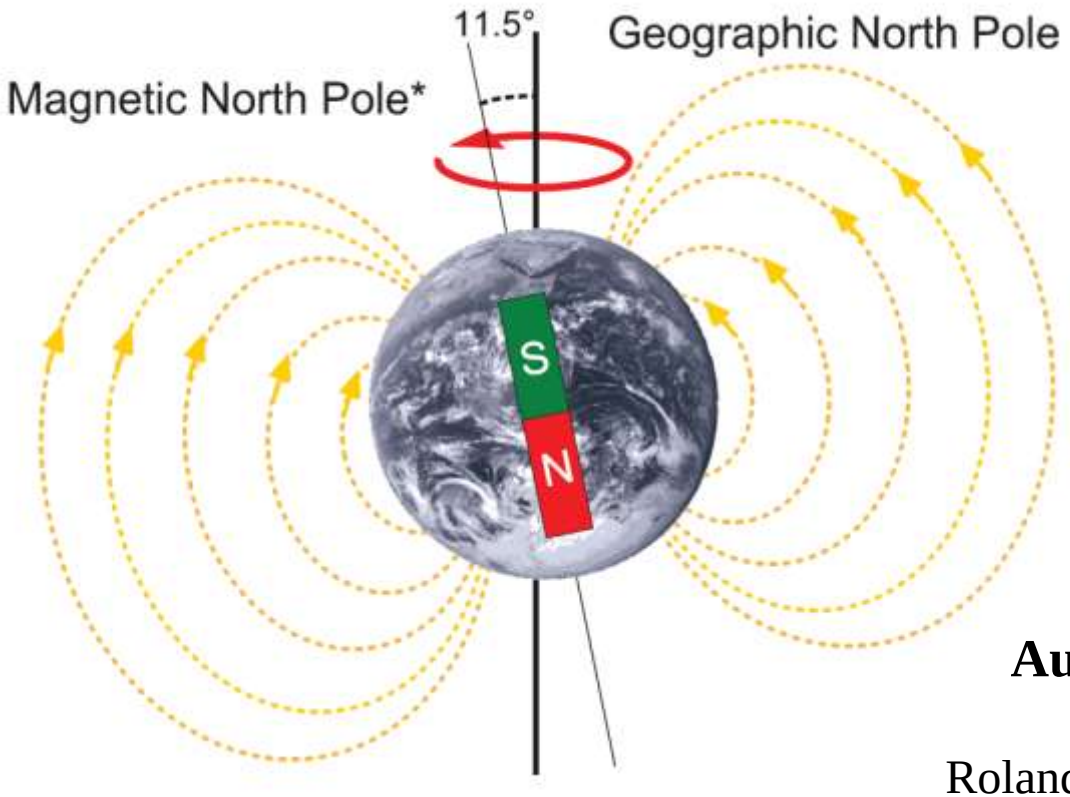

Tangent
R_R
R_L
Finish
R
O
Start






105,118
160,120

Challenge 2: Go North.

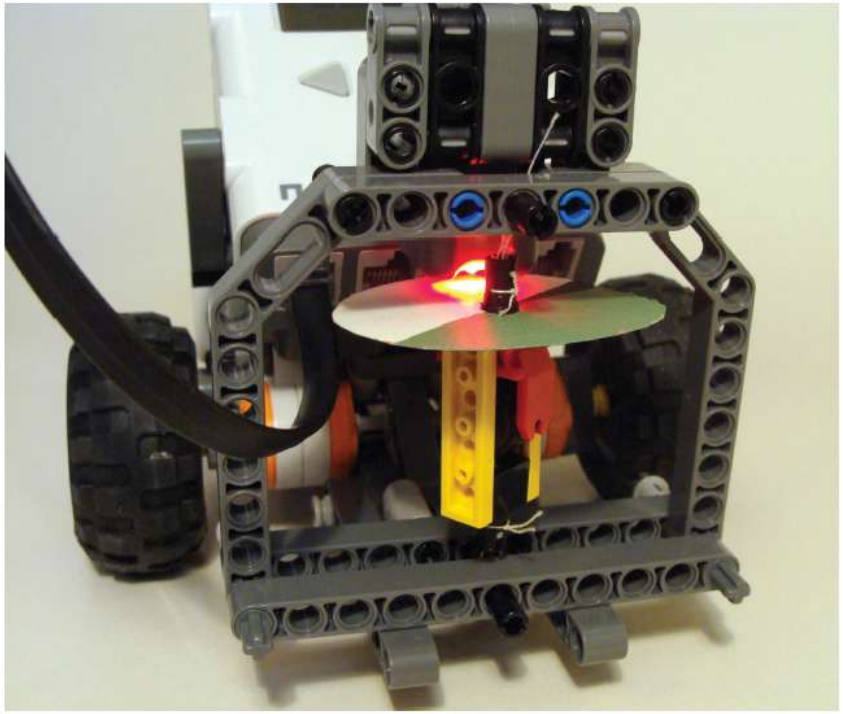


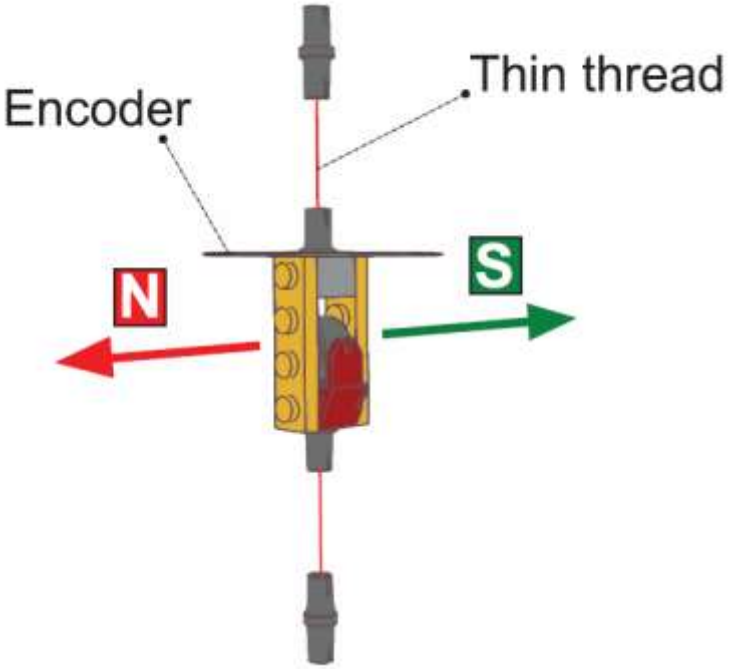
Introduction to Autonomous Mobile Robots

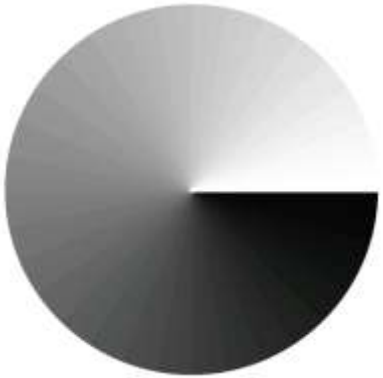
Roland **Siegwart**, Illah R. **Nourbakhsh**

The MIT Press (MA, 2004)

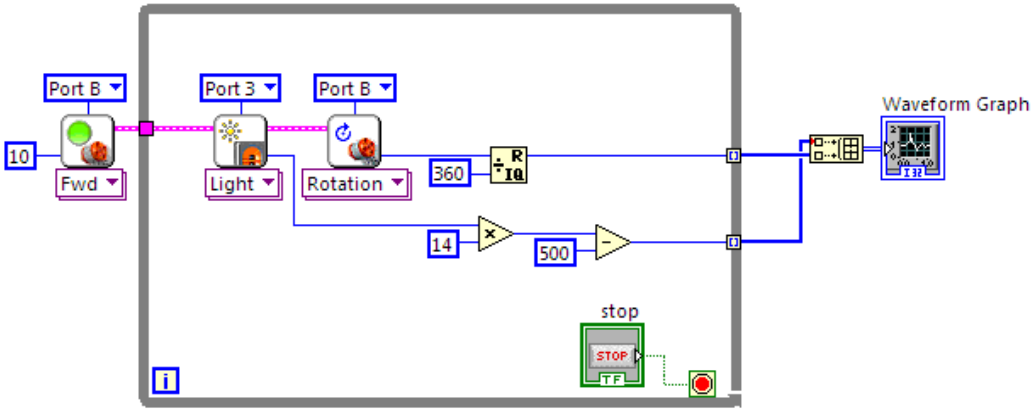
Robot solution







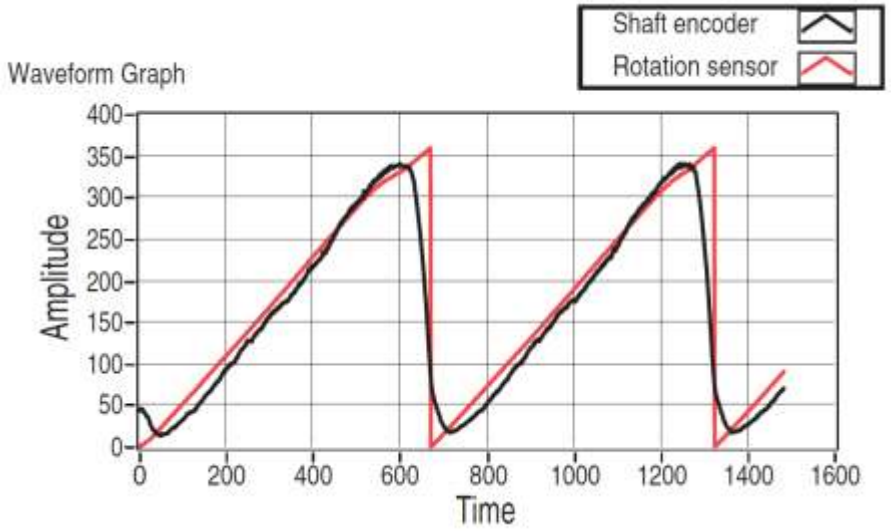
Yielding angles



$$\theta = a \cdot s + b$$

$$\begin{cases} \theta_{\max} = a \cdot s_{\min} + b \\ \theta_{\min} = a \cdot s_{\max} + b \end{cases}$$

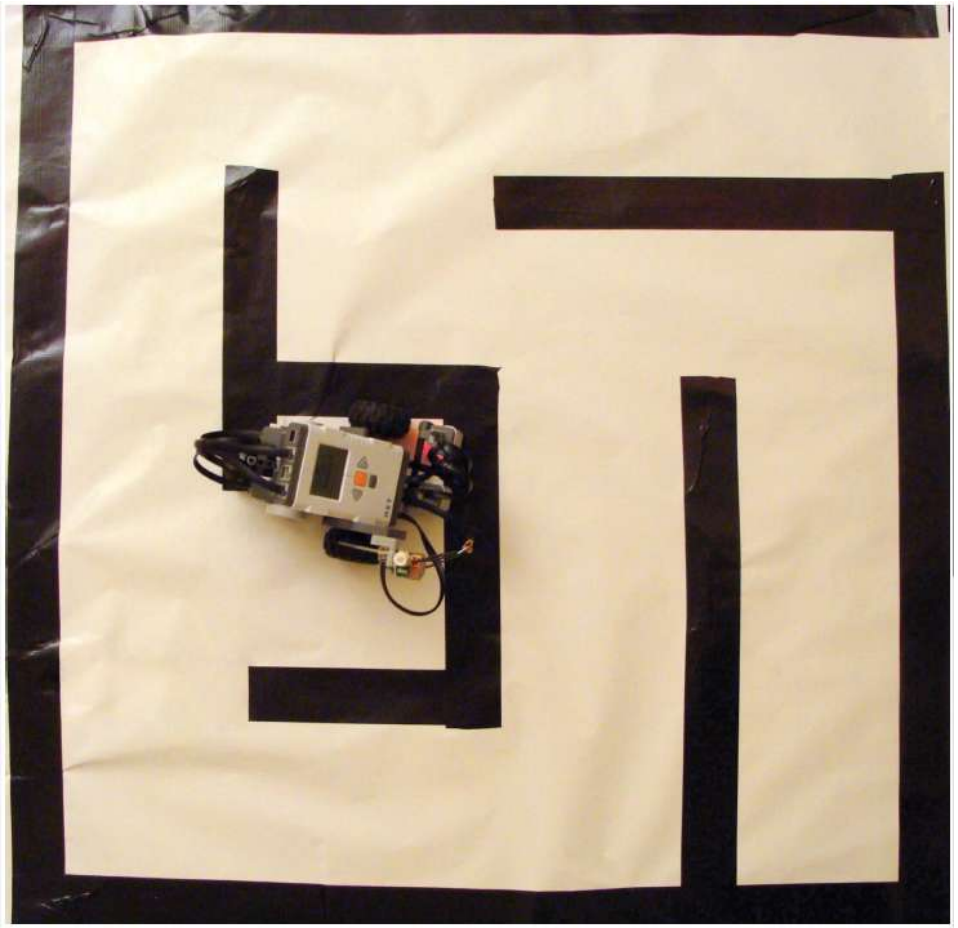
$$\Rightarrow a = \frac{\theta_{\max} - \theta_{\min}}{s_{\min} - s_{\max}} \qquad b = \theta_{\max} - a \cdot s_{\min}$$

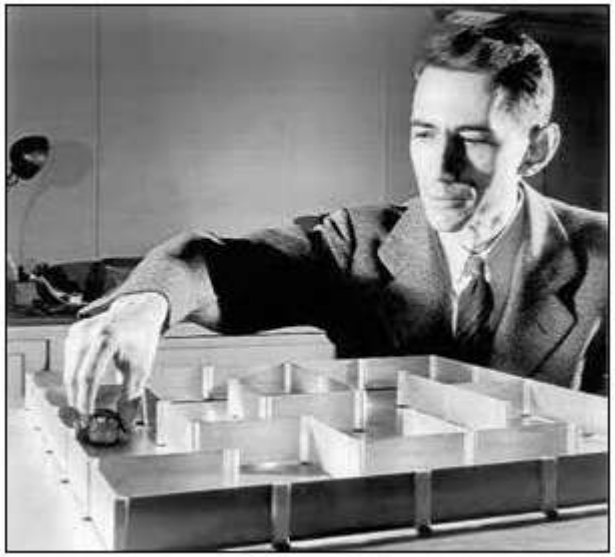


Challenges

- Get familiar with the material (LEGO / LabVIEW).
- Make sure, the solutions are within the students' reach.
- Choice of challenge → respect interest differences (age, gender, level).
- Easy to relate to regular curriculum content.
- May be solved within a few hours.
- Teach STEM (Science, Technology, Engineering and Mathematics) by design → Hands-on.
- Enhance the students' self-confidence.
- Foster the students' problem-solving skills.
- Have fun with team-work.
- Respect design rule: no hacking allowed at this stage → good exercise to stay within a system (and a set with limited parts).

Challenge 3: Get out of the trap.





Claude Shannon

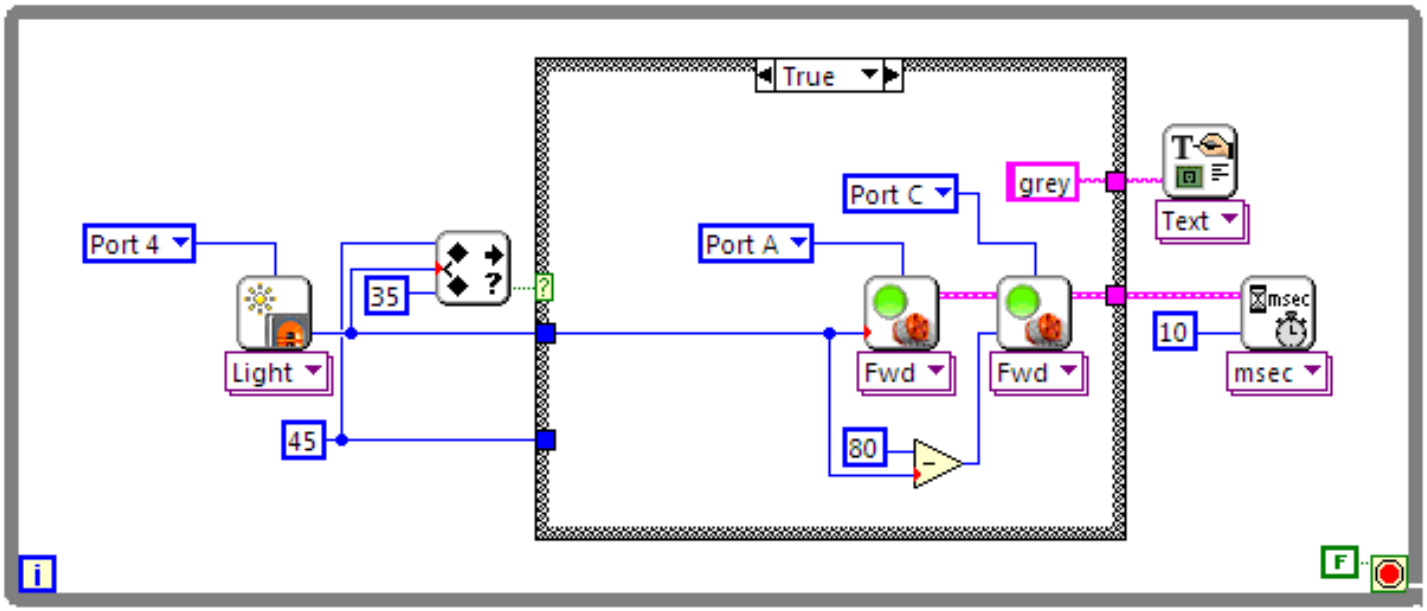
with his electromechanical mouse:

Theseus

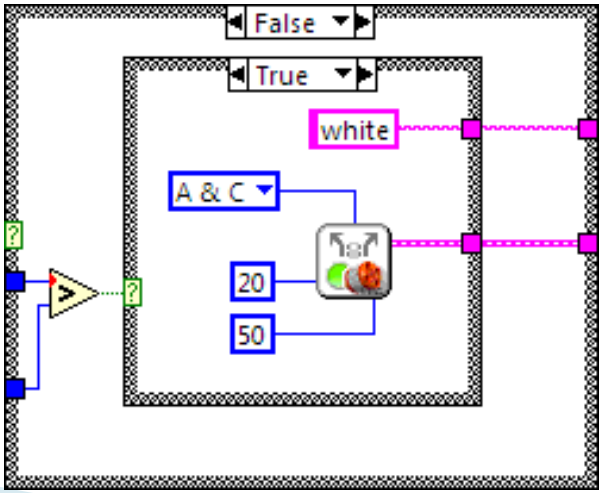
(1952)

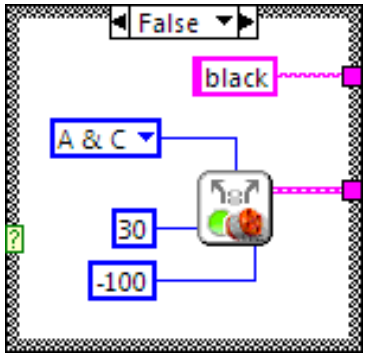
http://museum.mit.edu/150/20

Robot solution



LabVIEW implementation of the **Left-hand-rule** for perfect mazes.





BOULETTE INSTITUTE OF TECHNOLOGY

BIT ☺

High School Lab

Student teams that :

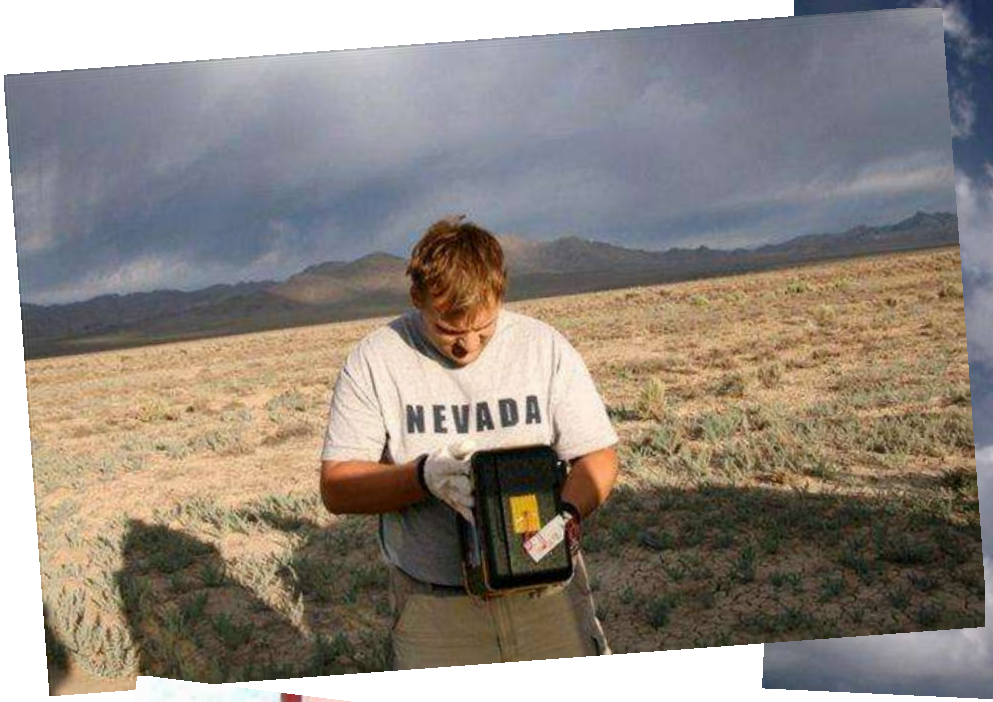
- ✓ Play with problems
- ✓ Do it themselves
- ✓ Never give up
- ✓ Have fun

CONVICT ÉPISCOPAL DE LUXEMBOURG

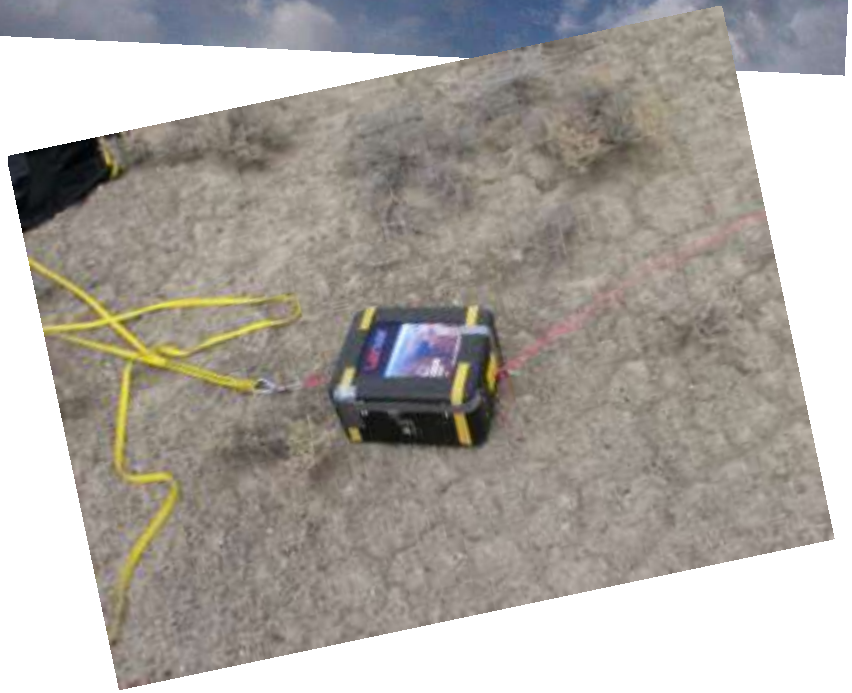
Grand challenges

NATIONAL INSTRUMENTS LabVIEW™

LEGO mindstorms


NEVADA


up

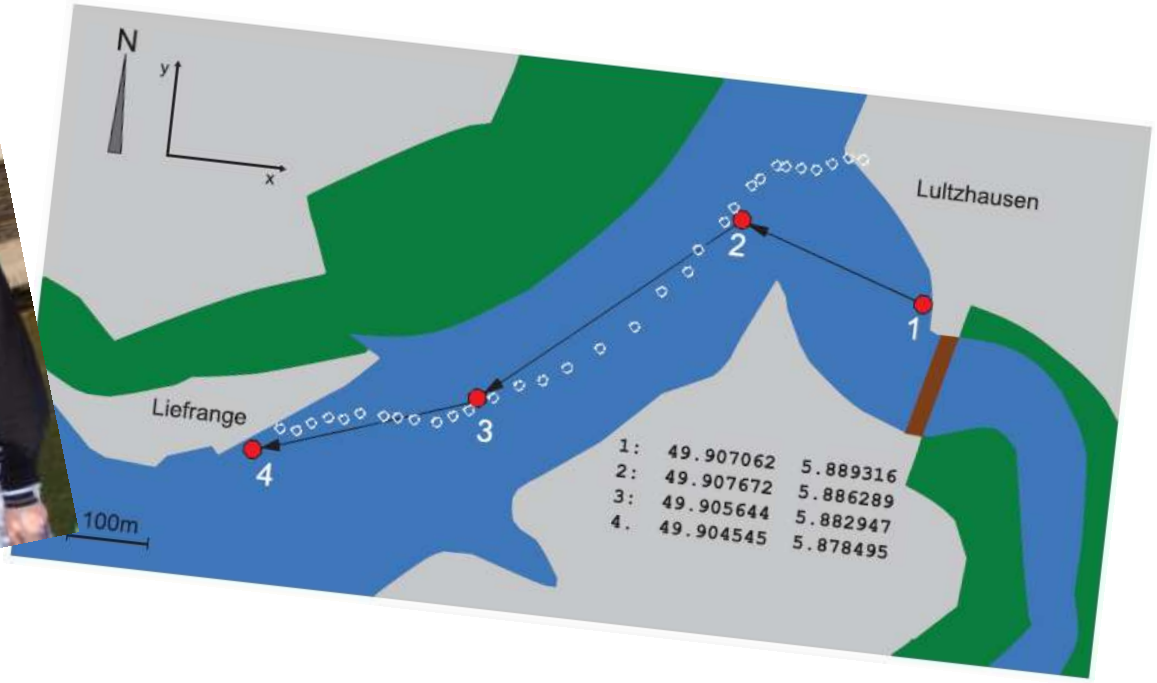


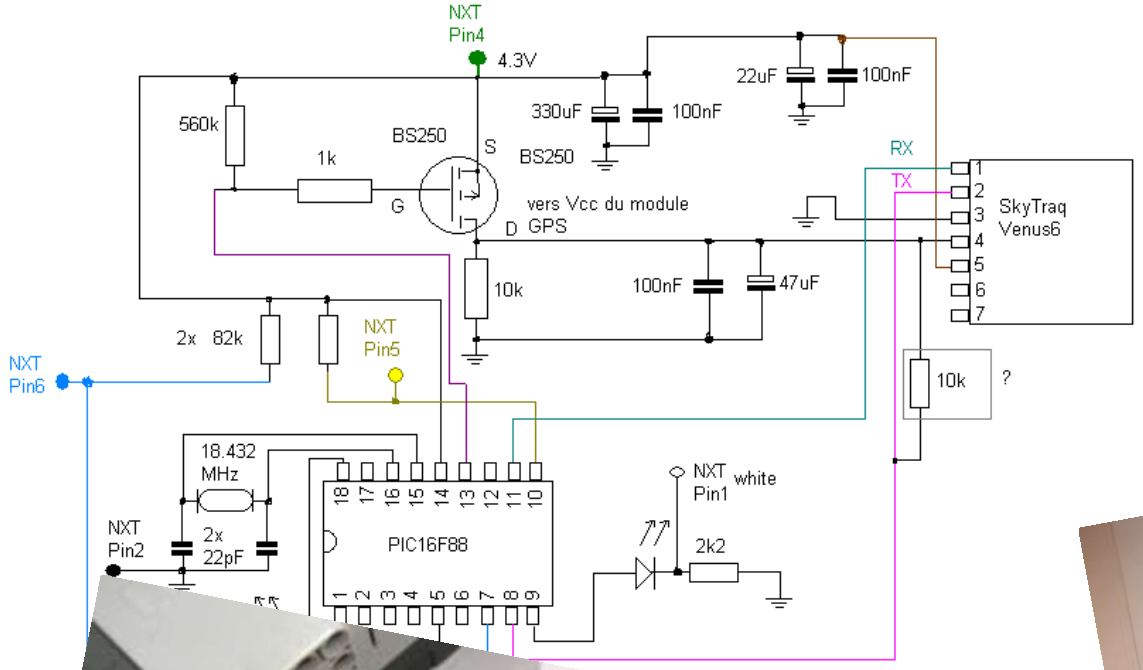
Grand challenges

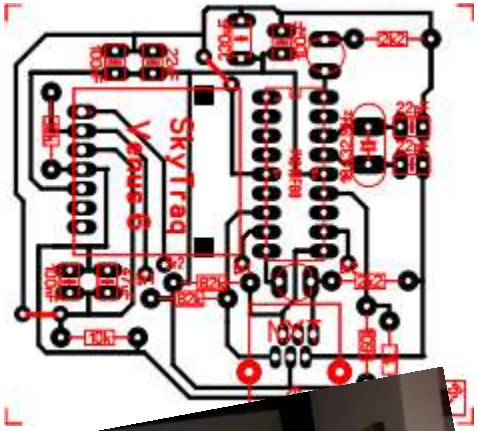
- Project-based learning.
- Team decides for the objectives and methods.
- Content depends on skills of the team members.
- Project always ends with a presentation.
- Hacking is «allowed», if there is no solution within the system.
- Project must be relevant and really challenging.
- Duration: normally 6 months -2 years.
- Team meets at least once a week.
- Development is shared in a blog.
- DIY is better than buying from the shelf.
- → **Generate interest for further studies of science, technology, engineering or mathematics.**

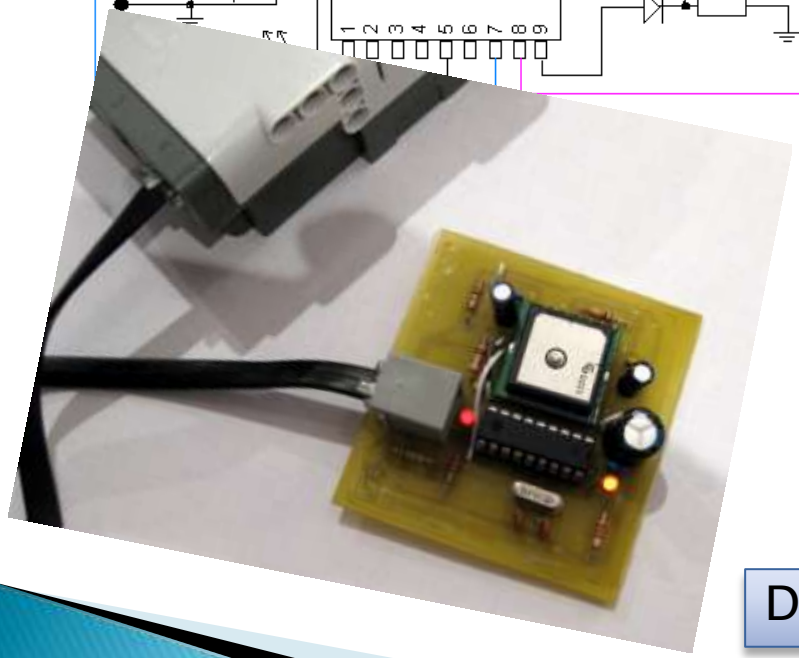
Project: Autonomous boat.

- **Occasion**: Adventure
- **Goal**: Cross the Lac de la Haute-Sûre
- **Duration**: 18 months

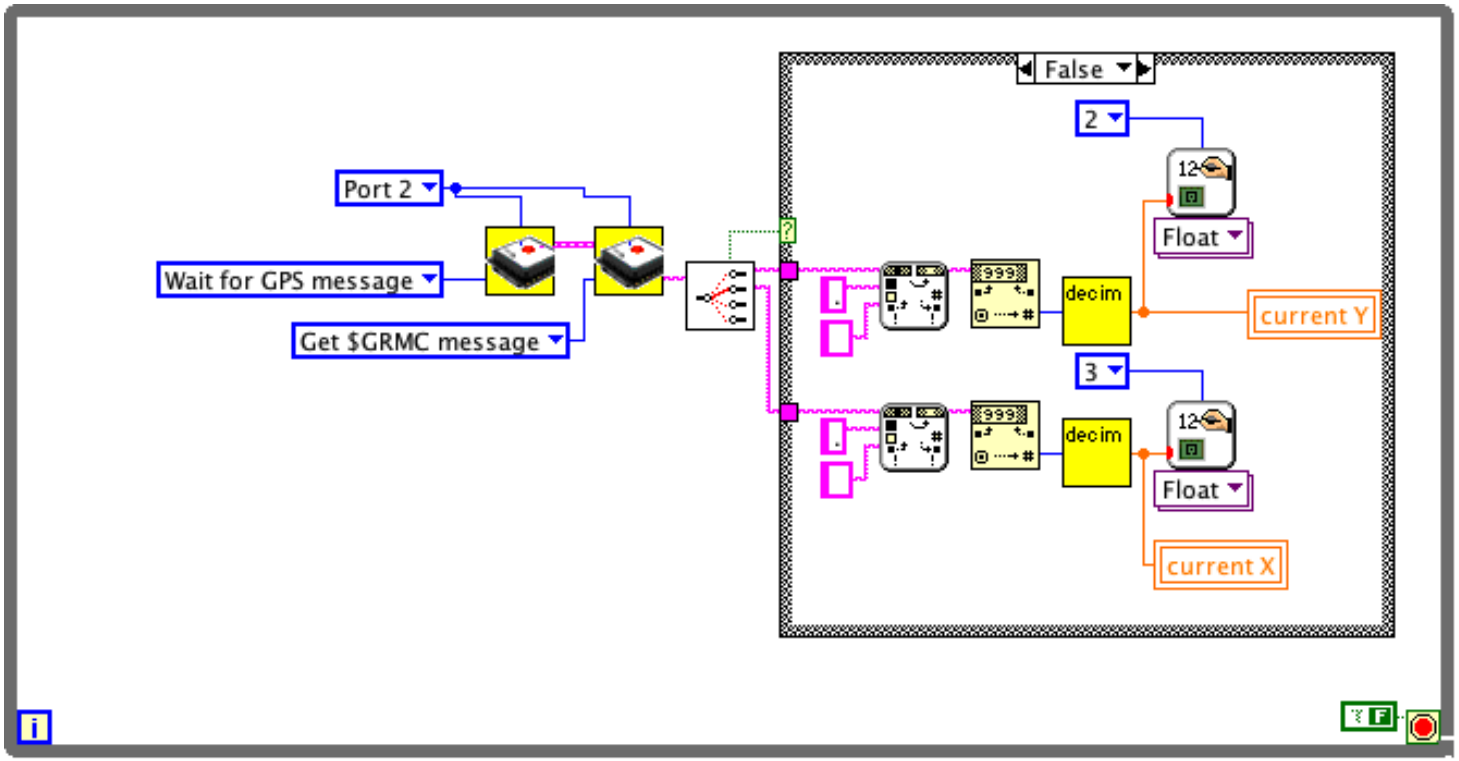


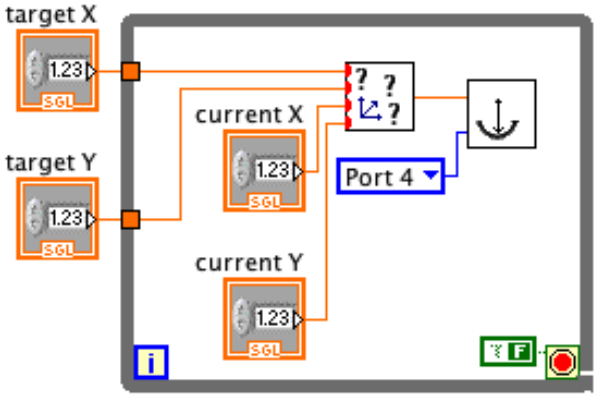






DIY GPS module





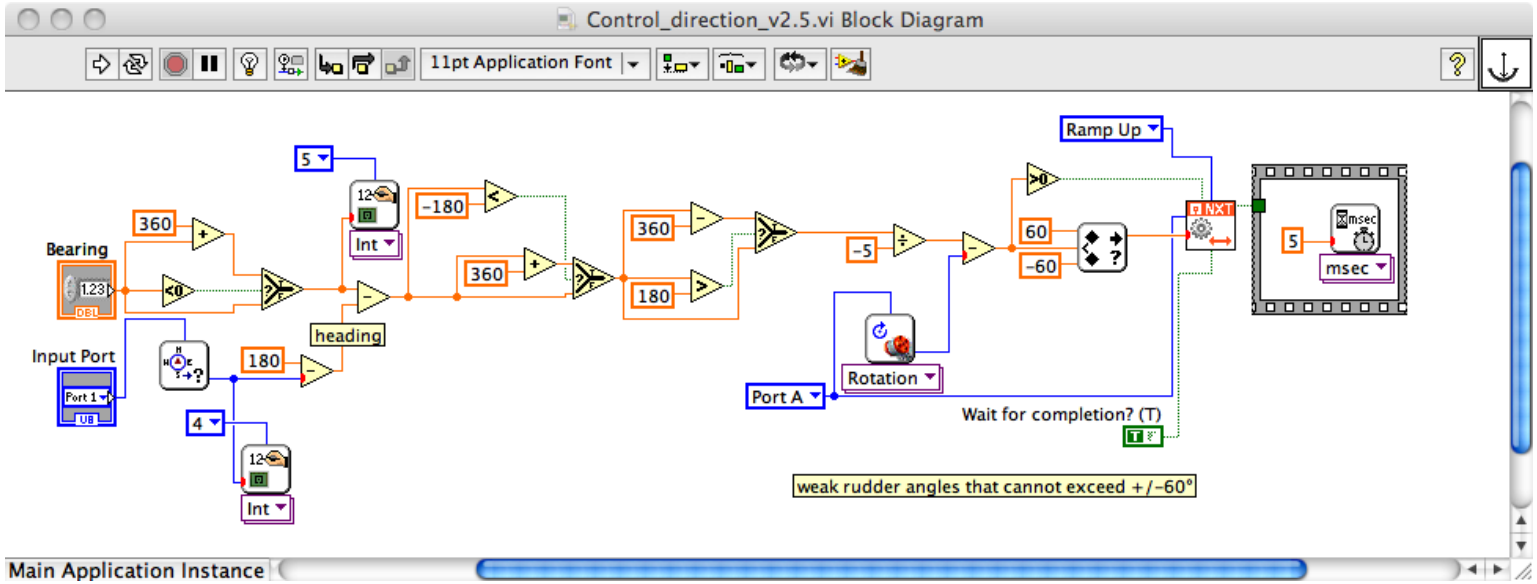
LEGO boat program:

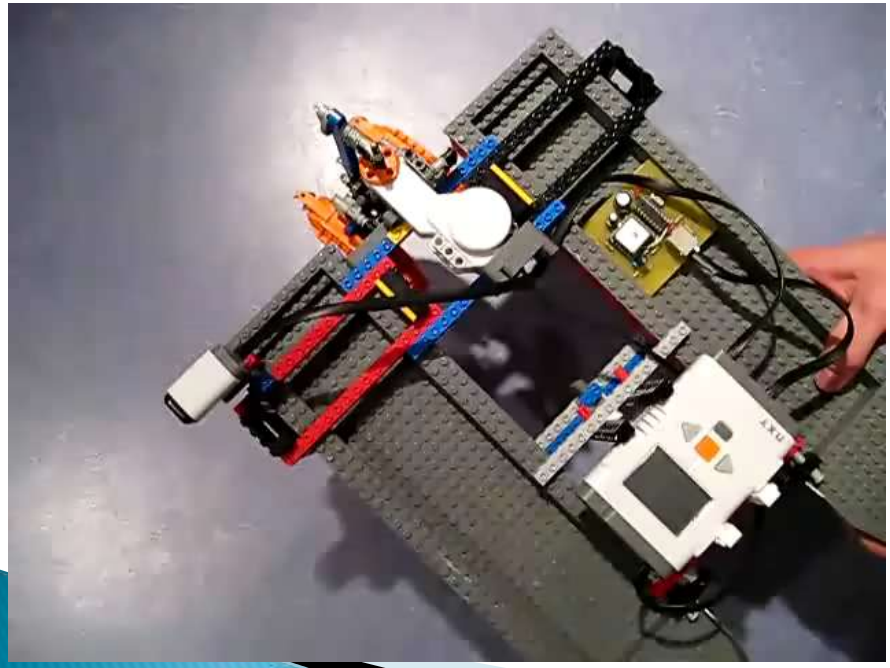
1. Extracts the longitude and lattitude as integer values.
2. Second task controls the rudder, in order to maintain the course in the direction of the target location.
3. The current bearing is calculated, and the rudder is adjusted.
4. Display line 1 is reserved for the analog value of Port 2 (GPS).
5. Line 2: lattitude; Line 3: longitude
6. Line 4: compass direction; Line 5: bearing

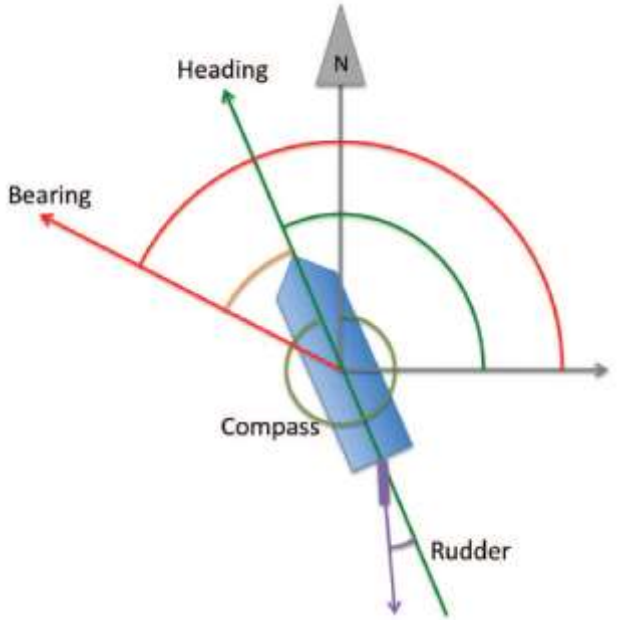
To Do:

1. Multiple target loop (with tolerance)
2. The longitude must be scaled in function of the lattitude. (Remember that one degree in longitude does not correspond to a constant distance.

Date: Nov 18th 2010
Authors: Stéphane, Tiago, Eric, Philippe, CB


Control_direction_v2.5.vi Block Diagram
11pt Application Font
Bearing
Input Port
Port 1
heading
Int
Ramp Up
Rotation
Port A
Wait for completion? (T)
msec
weak rudder angles that cannot exceed +/-60°
Main Application Instance




Heading
N
Bearing
Compass
Rudder


https://www.youtube.com/watch?v=NptlaZd-54k
$GPRMC,153305.021,A,4936.4375,N,00607.1863,E,000.0,000.0,060510,,,A*6E
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