Lego Mindstorm Track

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The problem

We need to build a robot which is capable to complete the given course as fast as possible while having a good design.

Analysis of the problem

The track is a black line painted on a paper, so we had to figure out some way to detect this line, so it could follow it. To detect the black line we used light sensors. Instead of using only one sensor we used two so it was able to detect both left and right turns on the black line.

Since the track isn't a straight line, we knew that we had to make a steering mechanism, so it could complete a course with bends and turns.

We used an ultrasound sensor to detect any obstacles it should meet on the course.

Solutions

This part of the report describes the two different solutions and the problems we had with the constructions.

Solution 1

The first solution had 4 wheels where two of them were in the back for creating propulsion while the third motor could turn the front wheels making it able to go left and right.

The problem we had was that the programming system couldn't handle the third motor combined with the two motors on the back.

Since we discovered this problem very early in the building process, we didn't get to install light sensors and ultrasound sensors.

Solution 2

With the experience we gained in the developing process of the first one we made a completely new design. Instead of using 4 wheels on the robot, we wanted to use 3 instead. The two front wheels should be connected to one motor each and the third wheel should be a "freewheel" which could turn 360 degrees.

Instead of having both our sensors pointing on the black line we had them pointing on each side of the line. Because of this adjustment the robot was now able to detect the black line every time it was about to cross it and then drive back on the track.

Another idea was that our robot should be sound controlled which means that we could make it start by clapping. This feature was more for the design purpose than a real contributor to solving the main problem.

Schedule

Day 1:

On day 1 we tried our first construction. It had 3 motors instead of just 2 as we used in our finial solution. We used the third motor as a steering device like a real car. The problem we faced was that the construction was too complicated for the microcontroller, so it couldn't meet the specification requirements since it couldn't make sharp turns.

Day 2:

After the experience we had on the first day we decided to make a new robot with a completely different design. Instead of having the third motor on the construction as a steering device we used the two motors on the front wheels to make it turn like a tank. One of the motors would slow down while the other didn't and the change in speed makes the robot able to make sharp turns. In the back of the robot we chose to have a small third wheel for stabilization.

Day 3:

We made the last tests and made videos of the robot on the tracks and completed the documentation.

Solution – 2nd robot

Materials used

To complete the given track we used:

- 1 Lego Mindstorm microcontroller.
- 2 light sensors
- 1 sound sensor
- 1 ultrasound sensor
- 2 electrical motors
- 3 wheels (2 sizes)
- Standard lego mind storm/technic bricks

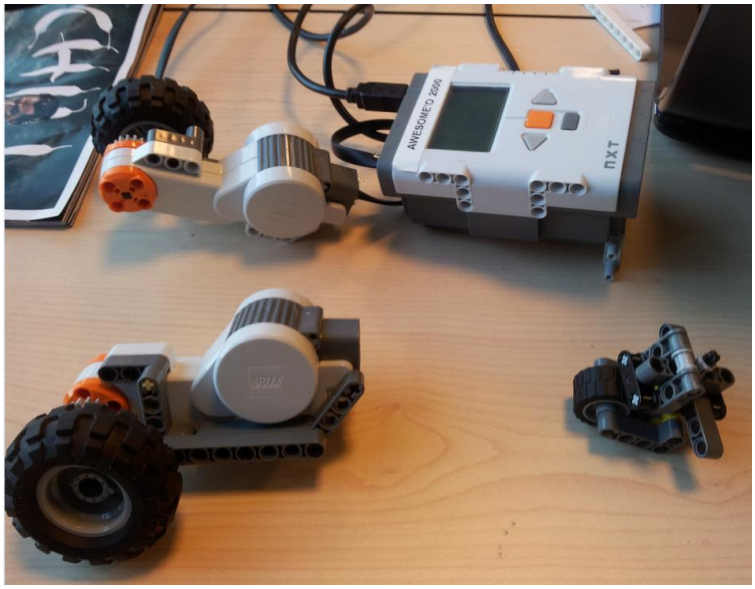
Specification

Our robot is able to follow the black line on the track, because of the two light sensors attached on the front of the robot.

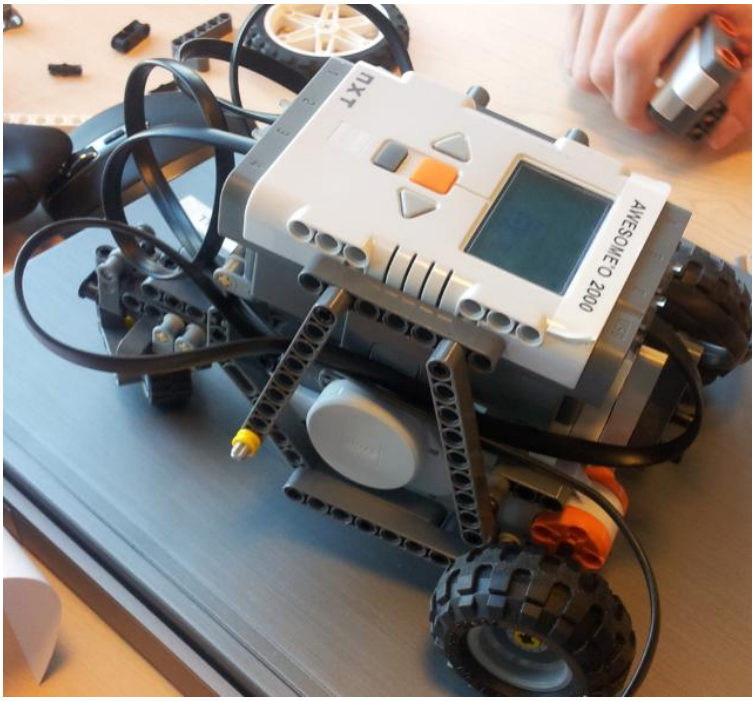
The robot is started by a clap because of the sound sensor.

It can detect obstacles on the course and make a 180 degree turn follow the line on the opposite direction.

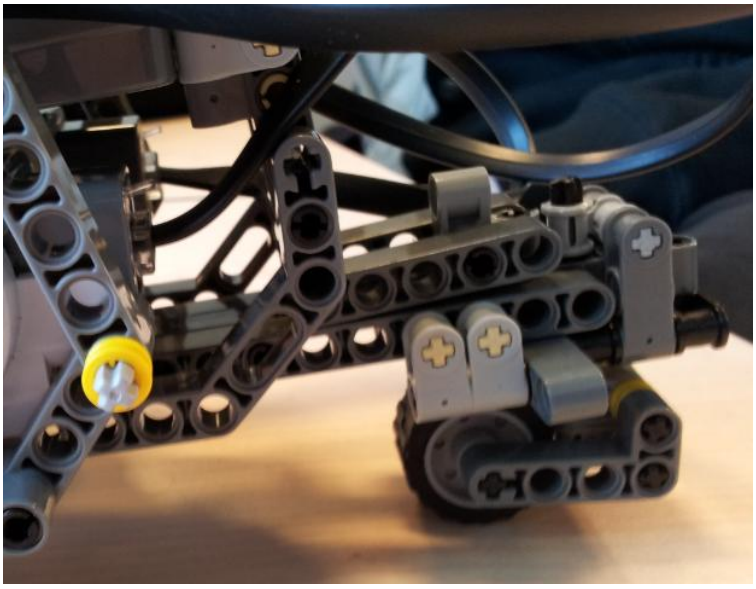
Instruction manual



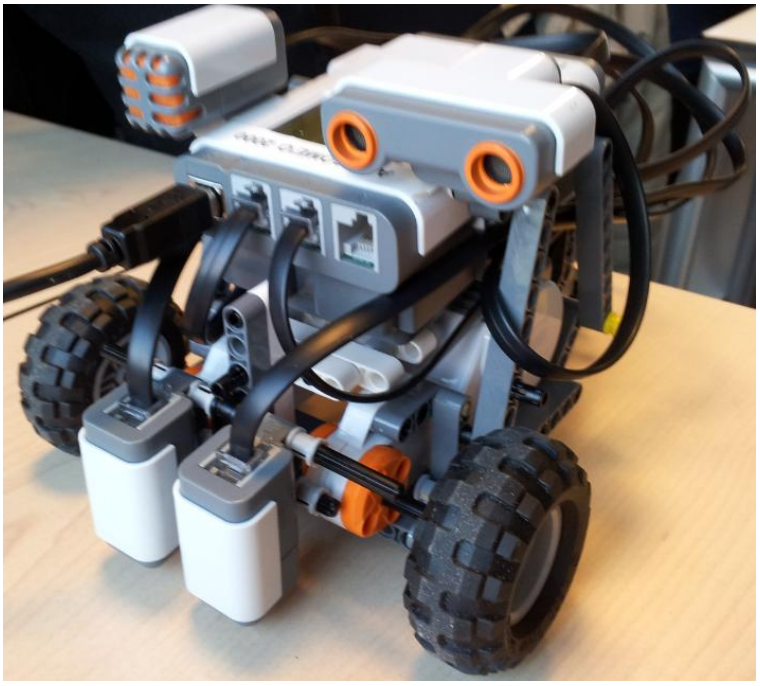
Picture 1: showing the two motors, the freewheel and the microcontroller.



Picture 2: The driving base with the two motors and the microcontroller on the top. All the sensors haven't been attached yet.



Picture 3: The third wheel seen from the side.

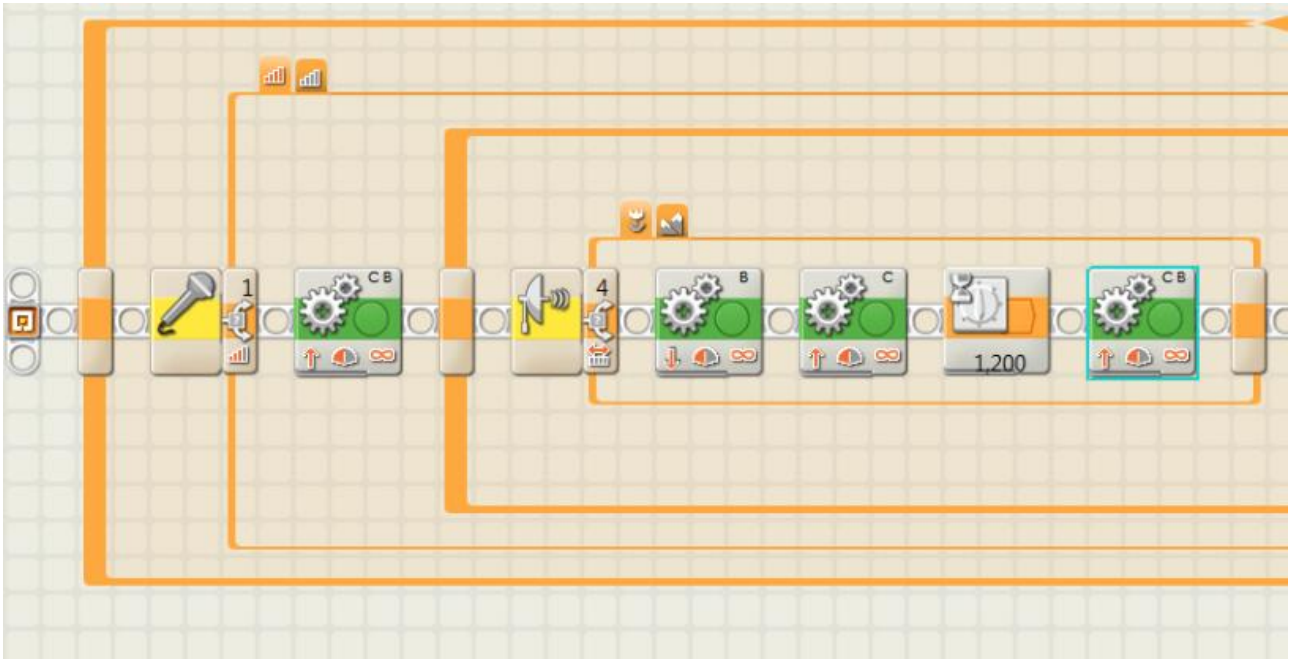


Picture 4: The final robot with all the sensors attached (two light sensors, one sound sensor and one ultrasound sensor).

Input	Output
1: Microphone	**A:** N/A
2: Left light sensor	**B:** Left motor
3: Right light sensor	**C:** Right motor
4: Ultrasound sensor	

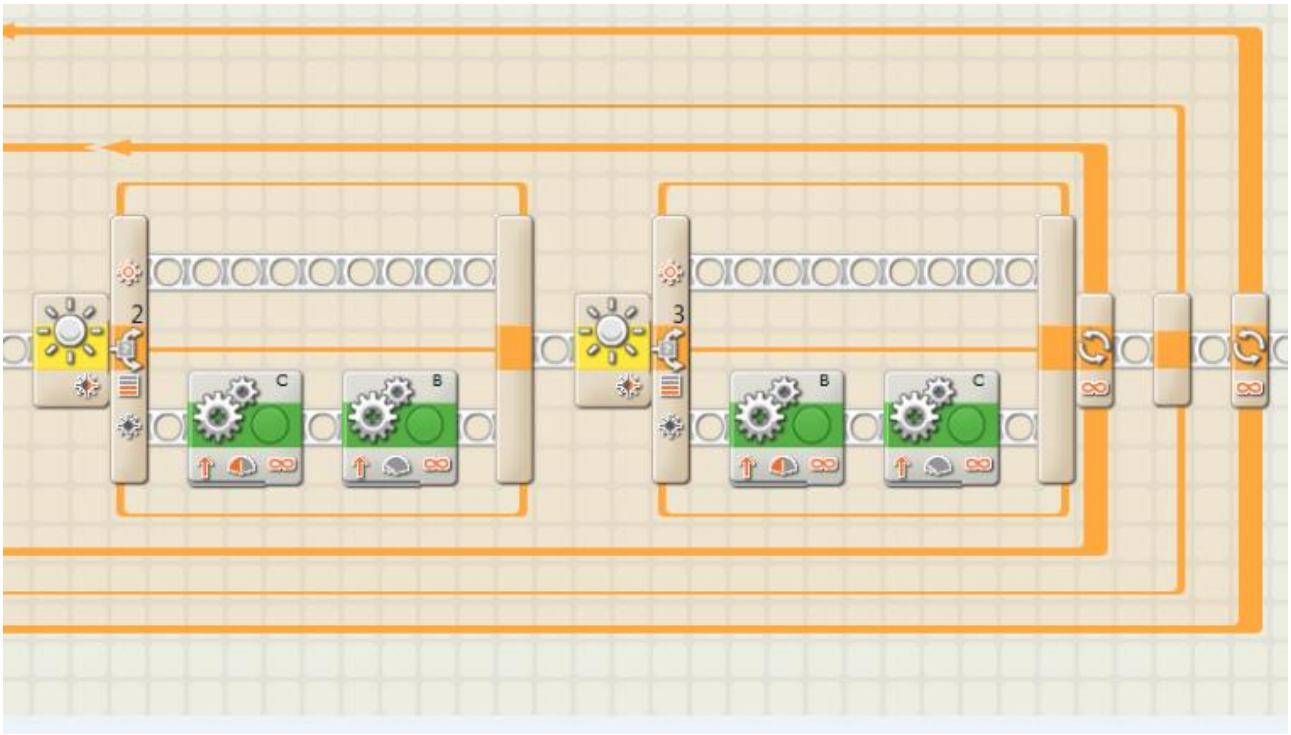
Programming

Part 1 of the programming:



1. In the beginning we have a microphone. When this microphone hears a sound it'll start the robot.
2. You can also see the ultrasound sensor. It checks for obstacles and if something comes in a range of 10 inches in front of the robot it'll turn 180 degrees.

Part 2 of the programming:



3. The third part of the program is controlling the left sensor. If the sensor sees the black line it will make the left wheel slow down, making the robot turn left.
4. The fourth part of the program is controlling the right sensor. If this sensor sees the black line it will make the right wheel slow down, making the robot turn right.

Conclusion

We were able to make a robot that could complete the course in 18.03 seconds. By using 2 light sensors the robot could detect the line underneath and therefore stay on it. It was sound controlled because of the microphone and it could detect obstacles in it way because of the ultra light sensor on the top.

Video of the robot can be found on the URL below:

http://www.youtube.com/watch?v=g3YjFAjKu8I