MMKN 30: Project #2 object removal/sumo

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Objective and main challenges

The main purpose with this project is to create an autonomous robot, also called agent. The construction has different kinds of sensors which can collect data. By interpreting the data the agent can make decisions depending on the surrounding environment.
There were two different tasks; object removal and sumo challenge. In the first task the robot removed five wooden cylinders and in the second the robot challenged another group's robot in sumo wrestling.

Concept and proposed solution

We tried a couple of different methods before we settled on a combination of a bang-bang and P-regulator. Below are some of the difficulties we encountered when planning for the object removal:

- Hard to identify wooden cylinders laying down
- Sensors finding the corner posts
- Blind spot when using double ultrasound sensors

These difficulties were overcome by altering the hardware and software setup until we had a result we were satisfied with. The final design is the one presented in the rest of the report.
Some challenges when designing the robot for the sumo objective were:

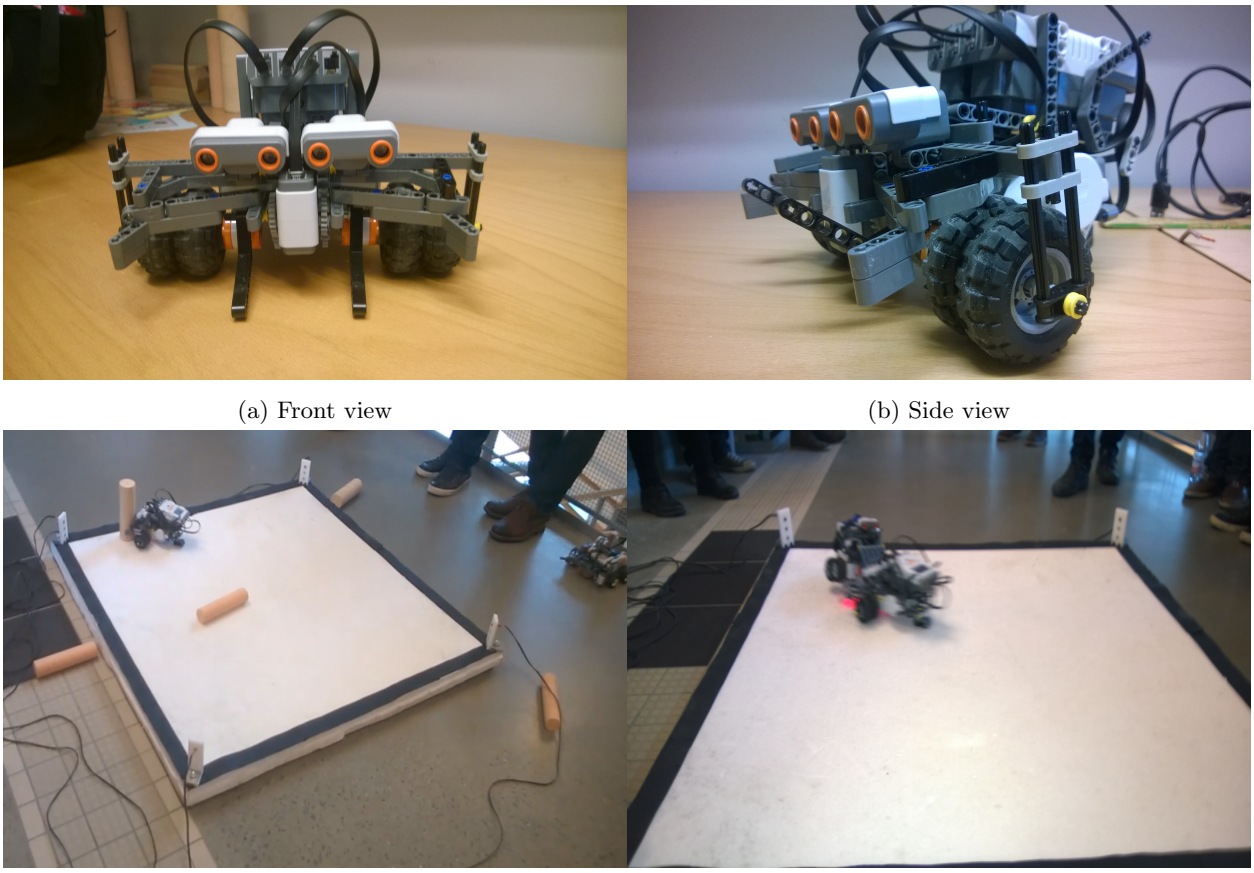
- Quickly identifying the enemy robot's position
- Capability to push with a large force
- Figuring out opponents' robot designs

The tricky thing with this part of the project was that we really had no way of testing how the robot would perform. All we could do was to maximize the features on our robot hoping that it'd be enough.

Mechanical design and building elements

Quite early in the construction process we chose to have front-wheel drive just like in the first project. We put three motors next to each other where the middle one would be used for lifting the opponents robot and the other two connected to the wheels.
We experimented quite a lot with the position of the ultrasound sensors. Here the hardware and software really had to be in symbiosis. The ultrasound sensors were a bit unreliable. Sometimes they would suddenly show a really high value followed by a low one, without anything in the environment changing. To overcome this issue we applied filtering of extreme values from the sensor. After some testing we placed the ultrasound

sensors next to each other. In this manner the robot would get a little bit of stereo vision.
A light sensor was placed in the far front of the robot. This would react when the robot was about to cross the border. Without this sensor the robot would fall off the board.
We had a lift in the front when we challenged other groups' robots. The purpose of this was to lift the opponents robot making our heavier and increasing the traction on the board. The opponents robot would lose traction, a win-win for our robot.



(a) Front view (b) Side view

(c) Clearing obstacles (d) In sumo wrestling match

Figure 1: Images of sumo-robot

Description of the program and its function

As we mentioned earlier we chose to have a bang-bang and P-regulator mixed. All the sensors were started using threads as this was the most efficient way to collect data. We decided to have three different states in which the robot would operate:

- Search mode
  In search mode the robot turned, drove forward, turned the opposite direction, drove forward, etc. During the time in search it would break out of the mode if any of the other ones were activated. You could say this is the least prioritized mode.

- Border mode
  This mode was activated when the robot crossed the border line. It would back up quickly and rotate 90 degrees. This is the only mode which was entirely fixed and could not in any way be effected by the surrounding.

- "Found something" mode
  This is when the robot identified something in it's surrounding; another robot or an object. The robot would at first drive slowly and as the distance to the object got smaller the speed would increase. This is the P-regulator in our code and it worked surprisingly well. When the left ultra sound sensor showed a lower value than the right the robot would turn just a little in this direction so the object would be in a straight aim.
  In this mode the lifting feature was embedded however only in the sumo challenge. The front forks would go up and down when the distance to the enemy was less than 20 cm.

Discussion

We decided to ignore the fact that our robot could see the corner posts. When a corner was identified the robot would drive towards it but kick into "Border mode" as it got close enough, taking robot away from the corner and the search after objects would again start.
Our robot was skilled when removing the objects from the board. It was smooth and precise. We came in second place with a time a little under a minute.
The sumo part of the project was the most exciting. It was cool to see how other groups has designed their robots' code and construction. Our robot did quite well and came in third place. We were very satisfied with the lifting device and it turned out better than we had hoped.

A video of the obstacle clearing can be seen on the following link:

`https://onedrive.live.com/redir?resid=11E66668F5F9EDBF!8876 ...`
`&authkey=!AFi6Ma6-_rw3rs8&ithint=video%2c.mp4`