Gymnasieskolan in Kristinehamn
Brogymnasiet

Co-funded by the
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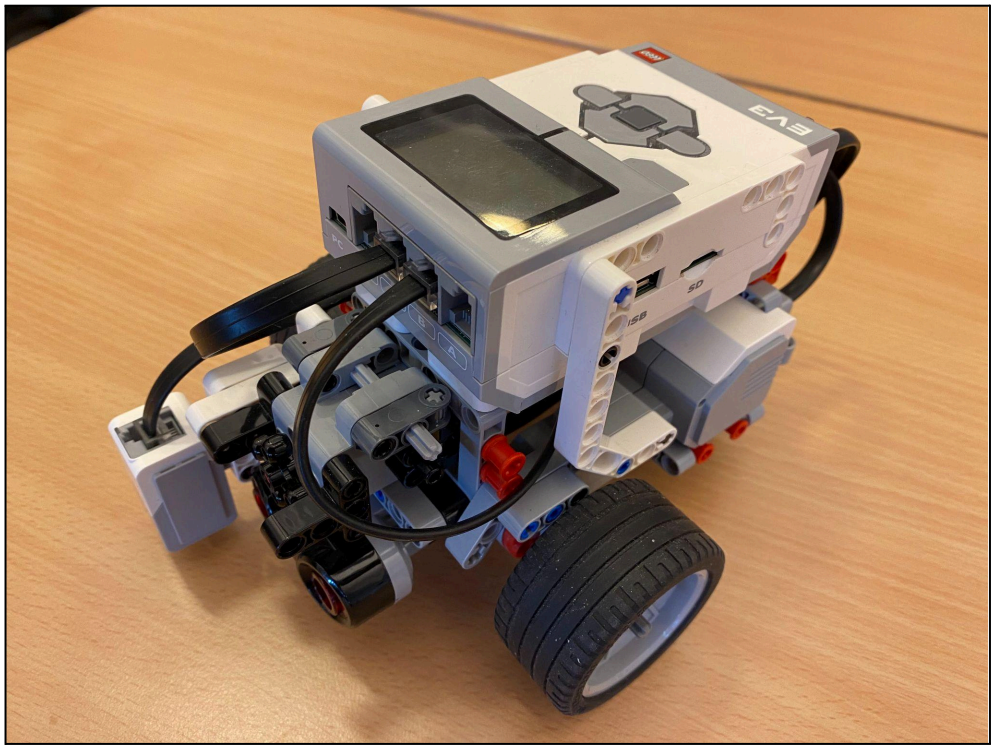
Programming Lego robot



Created by Anders Andersson
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Course summary

In the course, middle school students learn the basics of programming the LEGO MINDSTORMS logic unit EV3, which here controls motors in a car-like robot via inputs from ultrasonic and color sensors. The programming is mainly done with graphic symbols. Teaching and supervision is carried out by students in the high school's (upper secondary school) Technology Program.

Course facts in brief

Time: 90 minutes

Number of pupils: 24

Number of supervisors: 10

Number of groups: 6

Age of pupils: 10+

Prerequisites for students: None

Prerequisites for supervisors: Can program Lego robots.

Disclaimer

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Introduction

Background

Society's and business's need for people with technical knowledge is increasing at the same time as the interest in seeking technical educations is decreasing or at least not increasing to a sufficient extent. Something should therefore be done to get more young people to choose technical, both vocational and study preparation courses in upper secondary school.

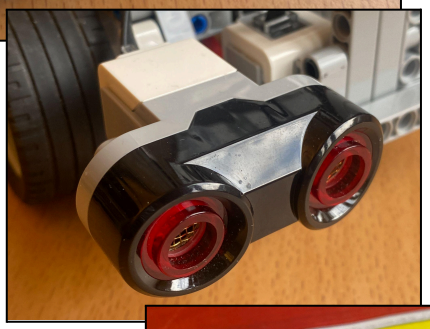
Purpose

The purpose of these lessons is to let younger students in elementary school come into contact with interesting technology they have not worked with before, while being supervised by older students who attend high school technical courses. The older students become a bit of role models and can then more easily transfer their interest in and attitude to technology to the younger students with their youthful enthusiasm.

Method

The younger students are tasked with solving a technical problem, for example programming a Lego robot, designing a game in CAD and printing it on a 3D printer, milling the game in the workshop together with high school students based on the drawing they created in CAD or as here do a website in Google Sites. To succeed in this, the older students must teach and guide the younger students in the current technology. Precisely the contact between the younger and older students regarding concrete tasks can create the conditions for both awakening and deepening interest in technology.

Programming Lego robot



Many children are familiar with and have built with Legos. However, the majority have not programmed before and LEGO's product MINDSTORMS with the graphically programmable device EV3 offers a good and fun introduction to programming. The focus here is not on building legos but on programming. The students get a ready-made car (here called a robot), which is driven by two controllable electric motors using input signals from an ultrasound sensor and a color sensor (see images on the right). How the robot reacts to obstacles and colors is programmed into the EV3 unit via a computer. The programming is graphical and is done with block symbols on the computer screen and thus not with code. In the course, the high school students will teach the younger students the basics of block programming of the EV3 unit.

Preparation in upper secondary school

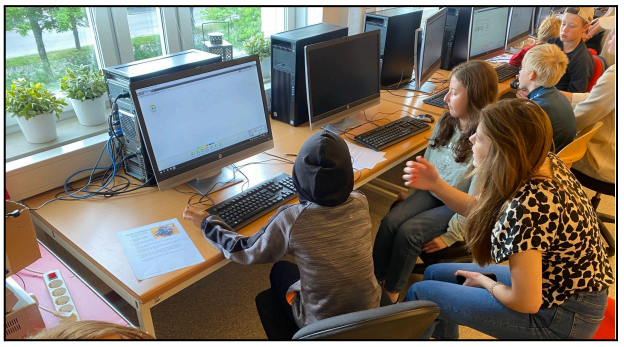
In the high school course Technology 1, the high school students have been taught and practiced the basics of block programming of Lego robots for about 10 hours, where the concepts of variables, loops and selection are central. They have also demonstrated their knowledge via an exam within the framework of the Technology 1 course.

An important part is organizing the teaching of the younger students in year 5, who are 24 in number. Since we want the younger students to work in pairs at a computer and we have six Lego robots, we have divided them into 12 pairs, corresponding to six groups, which means that two pairs share one Lego robot. Since a larger part of the time is spent on programming than on driving with the Lego robot, it works to share a robot. There are ten high school students who supervise and we also want them to work in pairs, in case someone is absent. This means that a pair of high school students supervise two pairs of younger students around a Lego robot. A pair of high school

Följande gymnasieelever är handledare:

1. Hilda, Noah
2. Isak, Sudan
3. Hampus, Ludvig
4. Fiona, Sina
5. Hannes, Helin
6. Hilda, Noah

students may also tutor two more pairs of younger students, according to the picture on the right of the group list. During the implementation, however, it was found that the tutors went around the classroom and also helped pairs that were not theirs. However, it is good to have a plan for the implementation, especially at the start of the lesson, when we placed a Lego robot between two computers.



We have also prepared a number of tasks (see the appendix) that the students must solve with increasing difficulty, where the ultrasound sensor and color sensor are included in the solution. However, everyone must be able to solve simpler tasks with an ultrasound sensor.

We discussed whether the lesson should start with a joint review for all students, but we concluded that the younger students will probably be more focused and inclined to ask questions if the high school students guide their respective groups quite directly when the lesson begins. Therefore, each pair of tutors has thought about how to set up their teaching, which initially involves showing the students how the robot is controlled directly with blocks, as well as with the ultrasound sensor. When the students have solved some tasks, it is shown how the robot is controlled with a color sensor. The lesson can end with a competition, where all robots start at the same time at a taped line a couple of meters in front of a wall. The robot that returns to the tape the fastest after turning against the wall using the ultrasonic sensor wins the competition. Since we are 12 pairs and only have six robots, two heats were run with six robots in each and a closing final with the best three from each heat.

Preparation in middle school

Middle school pupils do not need to prepare in any particular way. However, their teachers have been given the task of putting together 12 pairs of students who will collaborate on the Lego programming, and to think that the students in the pairs have the conditions to collaborate with each other, for example that they have similar drive and ability to solve a problem so that not one of the students dominates the collaboration.

Implementation

When the younger students arrive at the high school entrance together with their teacher, they are met by all the tutors (the high school students) and their teachers. When they arrived in the classroom, the teacher greeted everyone and told them quite briefly something about the Lego robot and what the students should do. The teacher then introduces the tutors and which group they will tutor. The tutors line up in turn as the presentation goes on at their computers and the younger students are asked to go to their tutor. The tutors then take over the teaching of their groups. The goal is therefore for the younger students to work in pairs at the computers. When there are 30 minutes left in the lesson, the competition is introduced by a tutor. Then the students get 10 minutes to solve the task, after which the first heat is carried out. After a few more minutes, when the six other groups have uploaded their programs to the Lego robots, the second heat is run. And finally the final, where the three fastest pairs receive a prize.

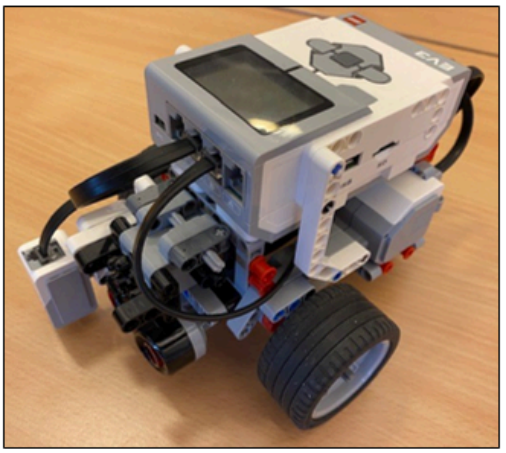
This can be completed in 90 minutes. With an additional session of 90 minutes, the first session can be devoted entirely to practicing and solving more tasks, while the second session is devoted to the competition.

Evaluation

When the students have completed the opportunity at the upper secondary school, an evaluation is made of how they experienced the course, as well as of how their teachers felt that the course worked for the students. The aim is to get tips on how we can improve future courses. The supervisors should also be allowed to evaluate their participation. The evaluation is preferably done with the Google Forms tool. Here is an example of the students' and teachers' evaluations.

Appendix

LEGO QUESTIONS



1. Make the car go forward for two seconds, stop and beep for one second.
2. Make the car go forward for one second, then reverse for two seconds.
3. Make the car drive straight ahead until it is one decimeter away from an object.
4. Make the car go straight ahead until it goes over a red light, then it should turn 90 degrees.
5. Make the car turn right as soon as it is closer to an object than 20 cm. If it runs over something black, it should make a tone with a frequency of 440 Hz for 1 second.
6. The car drives straight ahead. If it gets closer than 10 cm to an object, it stops, backs up about 20 cm, turns 90 degrees to the right, and then continues straight ahead until it encounters a new object.
7. *Make up your own task that uses both the ultrasonic sensor and the color sensor.

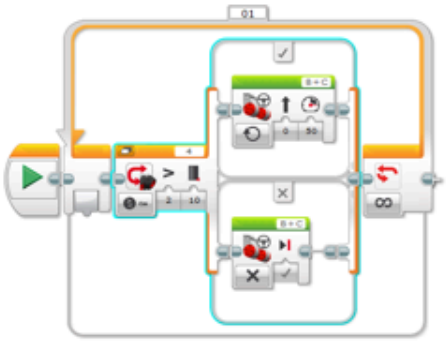
The students must solve the tasks with increasing difficulty.

Solution LEGO QUESTIONS:

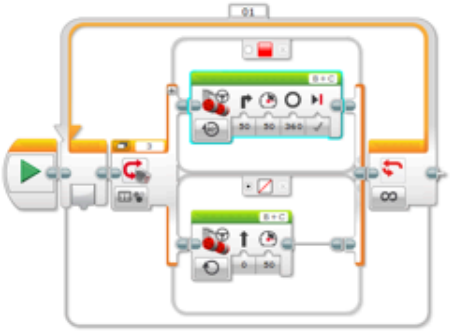
1. Make the car go forward for two seconds, stop and beep for one second.

2. Make the car go forward for one second, then reverse for two seconds.

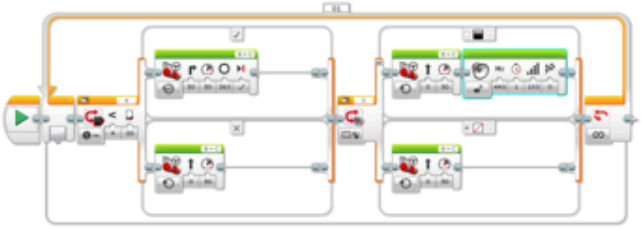
3. Make the car drive straight ahead until it is one decimeter away from an object.



4. Make the car go straight ahead until it goes over a red light, then it should turn 90 degrees.



5. Make the car turn as soon as it approaches an object and if it runs over something black it should make a sound.



Solutions to the tasks above.