

Engineering Portfolio

Team 21658



Emmauscollege Thunder Wonder

2022-2023

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Introduction

Welcome to the engineering portfolio of our team Emmauscollege Thunder Wonder! Our team originates from the school Emmauscollege in Rotterdam, The Netherlands. We are a rookie team this season (2022/2023).

Meet our team! Our team consists of twelve members:



Mohammed El Haji (Team Captain)	
Aaron van Elswijk (Software Engineer)	Alan Bakija (PR/Marketing)
Bobby Hitalessy (Mechanical Engineer)	Delnia Asgari (Software Engineer)
Klaus Preining (Software Engineer)	Lide Chen (Mechanical Engineer)
Maria Galagan (Software Engineer)	Pien Muller (Mechanical Engineer)
Reshano Dihal (Mechanical Engineer)	Xinyi Li (Software Engineer)
David Lans (Driver and 'The Joker')	Barry van Elswijk (Photographer)
Sander van Geest (Team Coach)	

Most of us are currently in the fourth grade of the Dutch school system, which is equivalent to the tenth grade in the American education system, except for Klaus (who is a year above us), and of course our team coach, mr. Lans and mr. Van Elswijk. The team used to be a lot smaller (seven members when entering the Rookie Challenge in July), but at present we have enough manpower to manage developing as a team.

Our goal as a team this year is to gain experience in the field of robotics, not only when talking about engineering the robot, but also to gather experience with programming, which is certainly essential, as only two members of our team, Klaus and our coach, have prior experience with programming in Java.

For anyone who reads this portfolio, we hope you will be enthralled by reading this!

Engineering Process

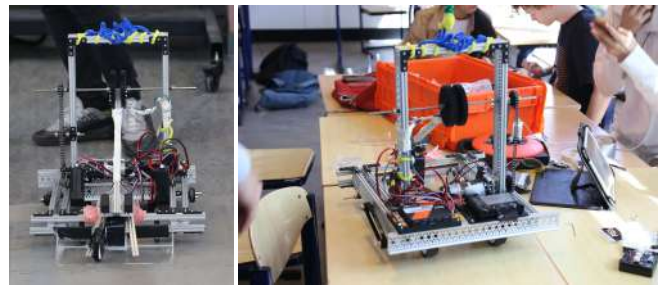
Hardware

Meet Peter (full name Peter the Betweter, a Dutch pun created by Lide Chen), our robot for this season!

In the previous school year (2021/2022), we participated in Robot In A Week and the LEGO League. In Robot in A Week, two of our current team members participated and created a robot, which is the foundation of Peter. He has changed quite a lot throughout the span of the past months, so let us begin with Peter during the preparation for the Rookie Challenge in July 2022 and how we created him.

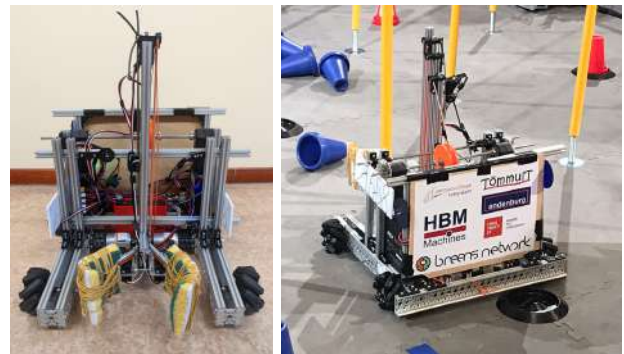


This robot has quite a simple, but bulky and sturdy design. The design did not need to be that complicated at first, because of the fact that the goal in this Rookie Challenge was quite straightforward. Our robot had wheels on the inside instead of the outside, and the arm was not extendable yet. Talking about the arm, it was not directly driven by a motor, but connected with a chain.



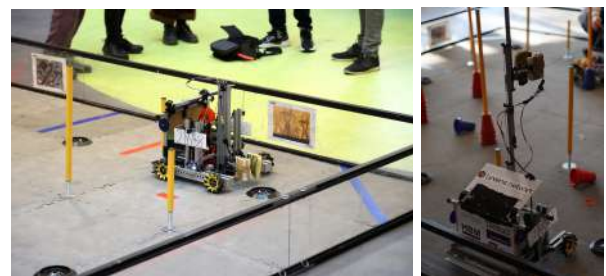
Peter during the Rookie Challenge

In preparation for the first league meet, we mainly concentrated on developing the arm of the robot, especially for picking up cones. We first tried using wheels that rotate in order to grip objects. Subsequently, we tried using a fishing hook, but unfortunately the hook didn't grip the cones tight enough. After constantly failing at finding a solution to this never ending problem, Mohammed came with the idea to use sponges with rubber bands, which finally gave us a way of picking up cones continuously.



Peter during the first league meet

After the successful performance of Peter at the first League Meet, we made a couple of changes to optimize him. We purchased a new set of wheels from goBILDA and it was child's play to install them. We added a small roof on top of the robot to prevent cones from falling into Peter. During this League Meet, a Core Hex Motor controlling the arm, broke during a test round. It appeared that we overloaded the motors, but we 'fixed' that problem by using a smaller spool.



Peter during the second league meet

Software

As mentioned earlier, we have participated in LEGO League and Robot In A Week (a week in the context of programming with robots with the same blocks system used in this competition). In spite of that, we didn't actually have any experience with programming in Java. When beginning with coding, it was solely with blocks. After a while, we started looking for tutorials on the internet, and commenced with actually writing code.

Autonomous

In this code we utilise a colour sensor to recognise the three colours on our cone sleeve (see image), and then, based on the colour recognised, the robot receives the instructions per field zone. The combination of the sensor and this program does not have a 100% success rate, something that can be improved (sometimes there is a faulty recognition of a colour, for example purple instead of green).



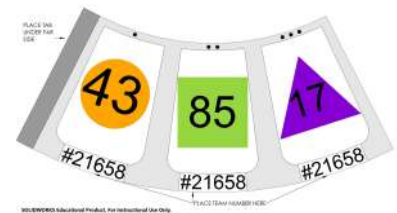
New signal sleeve

Op Mode Name
Zone_2_Center
Zone_3_Right
Zone_1_Left

At first the colour coding didn't work the way it was supposed to in time for the first league meet, so we just made three different codes for going to the three different zones and we picked one at random zones.

After the first league meet, we had the time to try and make a better system, so we tried to make use of a webcam together with pictures instead of colours, but that also didn't quite go according to plan. The pictures included a unique number for each zone. When we tried to implement this into

Old signal sleeve



the code, the webcam was unable to read these numbers, so we went for the colour approach instead. This ended up being the saving grace of the autonomous mode.

```
if (hue < 1) {
  telemetry.addData("Color", "unknown");
} else if (hue < 100) {
  telemetry.addData("Color", "Oranje");
  output = 3;
  scanned = true;
} else if (hue < 200) {
  telemetry.addData("Color", "Green");
  output = 1;
  scanned = true;
} else if (hue < 300) {
  telemetry.addData("Color", "purple");
  output = 2;
  scanned = true;
} else {
  telemetry.addData("Color", "unknown");
}
```

When the code is activated, the robot firstly moves forward until it detects an obstacle, afterwards it reads the colours with the colour sensor. After reading the right colour, the robot moves accordingly to the correct zone. If the robot reads the colour orange/red, it moves to the right side of the field, purple/blue only goes straight forward and if it sees green, it goes to the left side of the field. It took a long time to find the right hues of the colours and to fine-tune the distances of each zone, but in the end we got it working reliably.

OpMode (driver control)

Here is an example of our written code for the OpMode (driver control):

```
// Denominator is the largest motor power (absolute value) or 1
// This ensures all the powers maintain the same ratio, but only when
// at least one is out of the range [-1, 1]
double denominator = Math.max(Math.abs(y) + Math.abs(x) + Math.abs(rx), 1);
double frontLeftPower = (y + x + rx) / denominator;
double backLeftPower = (y - x + rx) / denominator;
double frontRightPower = (y - x - rx) / denominator;
double backRightPower = (y + x - rx) / denominator;

maxSpeed[0] = frontLeftPower;
maxSpeed[1] = frontRightPower;
maxSpeed[2] = backLeftPower;
maxSpeed[3] = backRightPower;

if (gamepad2.a || gamepad2.b || gamepad2.x || gamepad2.y){
    gears = 0.75;
}
```

```
// there might be an issue where the wheelspeeds don't update at the same time, which causes issues
for(int i = 0; i < currentSpeed.length; i++){
    if(rx == 0){
        if(maxSpeed[i] == 0){
            if(stopped[i] == 0){
                // if (stopped[i] == 200){
                // currentSpeed[i] += -1;
                // }
                // stopped[i] += 1;
                // if (stopped[i] == 200){
                // currentSpeed[i] = 0;
                // }
            } else {
                // }
            }
        } else {
            if(maxSpeed[i] < 0){
                if(currentSpeed[i] < maxSpeed[i]){
                    currentSpeed[i] += speedIncrease;
                }
            } else {
                if(currentSpeed[i] > maxSpeed[i]){
                    currentSpeed[i] -= maxSpeed[i];
                }
            }
        }
    } else if (maxSpeed[i] < 0){
        if(currentSpeed[i] < maxSpeed[i]){
            currentSpeed[i] += speedIncrease;
        }
    } else if (maxSpeed[i] > 0){
        if(currentSpeed[i] > maxSpeed[i]){
            currentSpeed[i] -= maxSpeed[i];
        }
    }
}
```

With the use of our Mecanum Wheels (newer ones recently installed), we can drive our robot in essentially any horizontal direction. This code is for the driving of the robot (which occupies one controller). Next to this, we also have code for our robot arm to pick up, raise and lower a cone.

```
while (opModeIsActive()) {
    double y = gamepad2.left_stick_y; // Remember, this is reversed!
    double x = -gamepad2.left_stick_x * 1.1; // Counteract imperfect strafing
    double rx = -gamepad2.right_stick_x;

    Arm_Left.setPower(-(gamepad1.left_stick_y - gamepad1.left_stick_y));
    Arm_Left.setPower(-(gamepad1.left_stick_y + gamepad1.left_stick_y));
    Arm_Right.setPower(-(gamepad1.left_stick_y - gamepad1.left_stick_y));
    Arm_Right.setPower(-(gamepad1.left_stick_y + gamepad1.left_stick_y));

    if (gamepad1.b) {
        ServoPosition += ServoSpeed;
    }
    if (gamepad1.x) {
        ServoPosition += -ServoSpeed;
    }
    // Keep Servo position in valid range
    ServoPosition = Math.min(Math.max(ServoPosition, 0), 1);
    Servo_Left.setPosition(ServoPosition);
    Servo_Right.setDirection(Servo.Direction.REVERSE);
    Servo_Right.setPosition(ServoPosition);
    sleep(20);
}
```

Program for arm

This code also occupies a controller. So now we have a member (currently our team captain Mohammed) controlling the driving of the robot, and a member controlling the arm movement (currently Lide). This program inherently uses two Core Hex motors to raise and lower the arm to a specific height preset per situation (for every pole). While having certain heights preset, we can also employ a joystick to manually change the vertical position of the arm.

Team Plan

When we first started with the First Tech Challenge, we did not have any experience with running any kind of business. Along the way, we learned how to approach companies, the best way to get sponsorships, create (social media) exposure and much more.

Sponsors

We first reached out to different companies in the area (Rotterdam) via e-mail. Our strategy was clearly stating who we are, what we do and what we need from that company/future sponsor. We thought it was a good idea to create a template that we could slightly adjust, depending on the company. The efficiency went up this way. To be clear to the sponsors, we made packages ranging from 250 euro all the way up to a 1000 euro. We labelled them: bronze, silver, gold and platinum. What was the difference between the packages? Well, for the bronze package, we would put their logo on our robot. For the silver package, we put their logo on hoodies that we made. The third package contained the conditions that we put the company's logo on both our hoodies and the robot. The last and most expensive package contains the same conditions as the gold package, with the addition that we thank them on our Instagram page. We mostly reached out to tech and construction companies.

Unexpectedly, the companies responded very quickly. Within a few business days, we managed to get our first sponsor, Constructif. Of course, we were very happy and proud that a team with no previous experience in sponsorships, was able to get a sponsor this quickly. The following weeks, we continued with our strategy of sending as much e-mails as possible. However, this time we also reached out to companies that weren't necessarily in Rotterdam or even related to tech or construction. It proved to be successful, as we got seven more sponsors that were willing to help us.

Outreach

Since this is our first year in the First Tech Challenge, we could not do as much outreach as we actually wanted to. But, we definitely have done some things. For example, we introduced children from groups 7 and 8 (5th and 6th grade) to our robot on the open day of our school. We made a little parkour they could drive through, which even included a ramp! They had a lot of fun driving around and we are certain that they will end up in the First Tech Challenge in the future!

