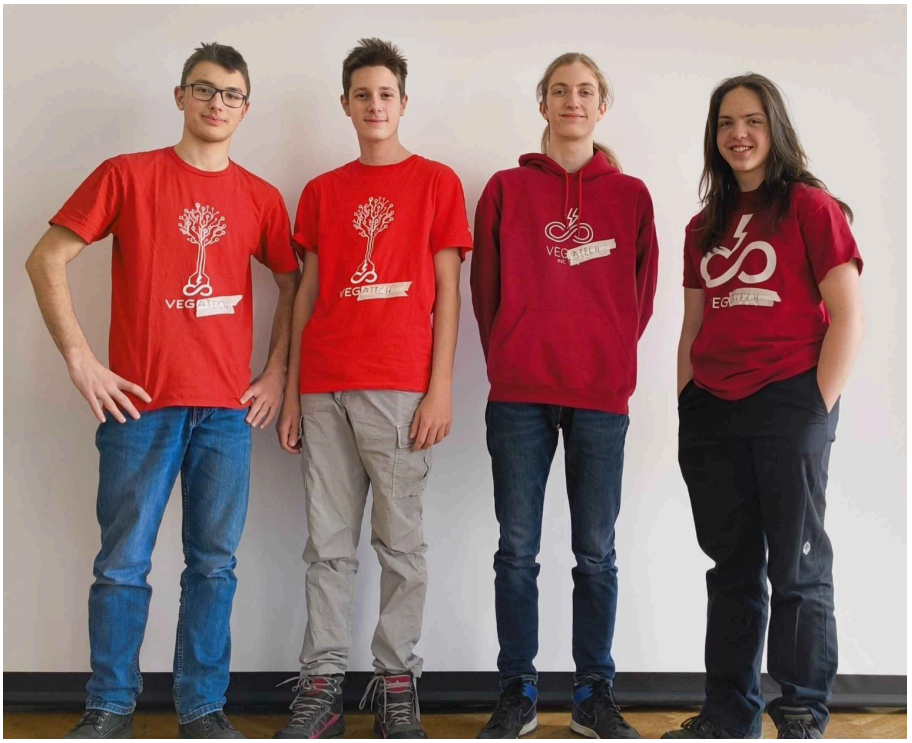
FIRST Tech Challenge

ENGINEERING PORTFOLIO

Team 28080 VegaTech 2025



Ljubljana, 2025

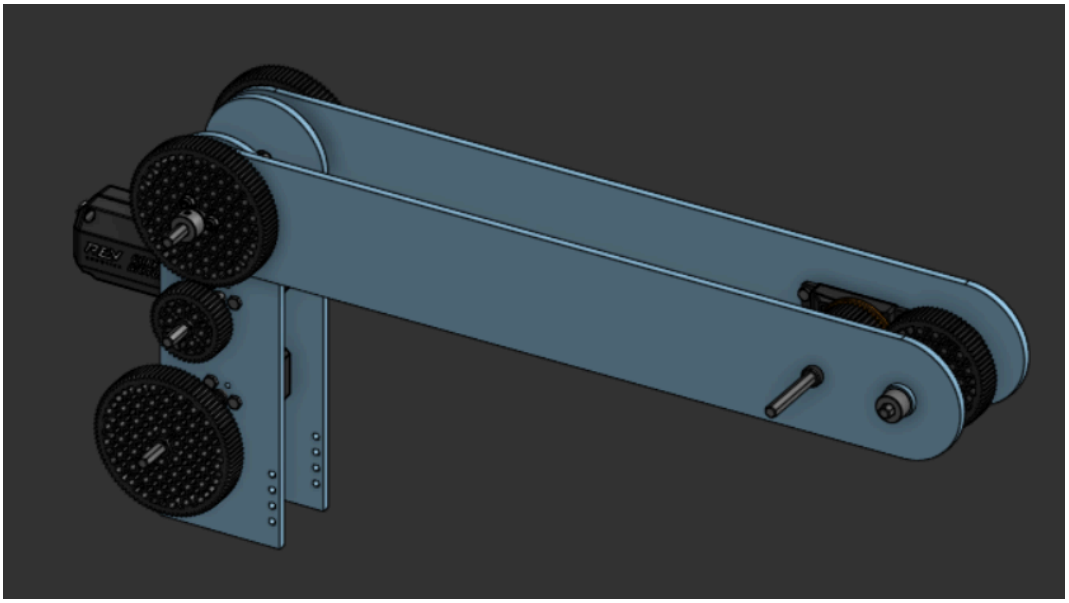
FTC 2024 VegaTech engineering notebook

About us

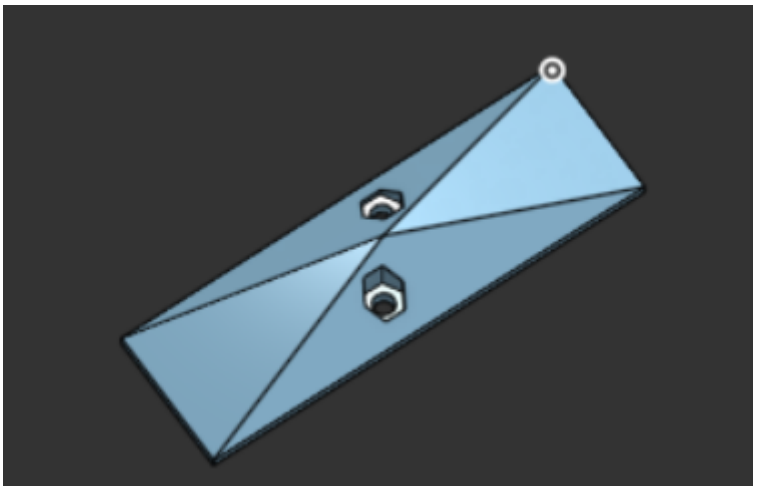
We are VegaTech, a small robotics team operating out of Ljubljana, Slovenia, attending our first ever *FIRST* Tech Challenge. All of our members (and the members of our mentoring team VegaMind) hail from the same highschool, so we are all very good friends. Because of this, communication and teamwork comes easily to us, and is one of the cornerstones of our team. We consist of a few junior members, attending their first robotics competition (Domen, Aljaž, Jon, Emir), and a few senior members who have competed in the *FIRST* Global Challenge before (Luca, Iztok, Matic). Using our combination of skills in STEM, we plan to take the FTC by storm and show that even though we are young, we have the power to make a name for ourselves.

Stuttgart Scrimmage:

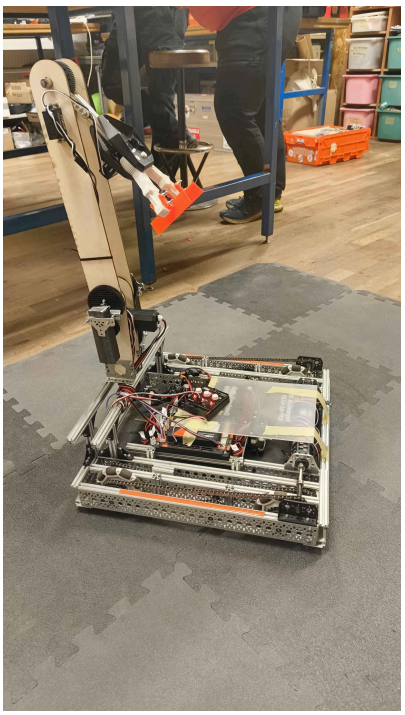
Our first obstacle to overcome was the looming scrimmage in Stuttgart, that we were invited to by local teams since we instantly became friends. Since our team had just been formed, we had not yet come up with a design for our drivetrain. We had to improvise and tore down a previous FGC robot to its bare bones and started to design a gripper that could be mounted to it. At first we wanted to use REV linear slides, but we soon realised that that was not to be, as we weren't satisfied with the result. As such we decided to make a 2-joint arm out of laser-cut wood, with a custom gripper at the end.



Our gripper was made out of 2 3d-printed pyramids that are made to perfectly fill out the hole in the SAMPLE game object. Using this design, we do not have to be perfectly centered to be able to pick up a SAMPLE.



Our only problem with this robot was the amount of strength needed to move the arm. We quickly fixed this problem, as we realised we could just attach 2 heavy metal cubes as counterweights, and it was solved. Great success!!

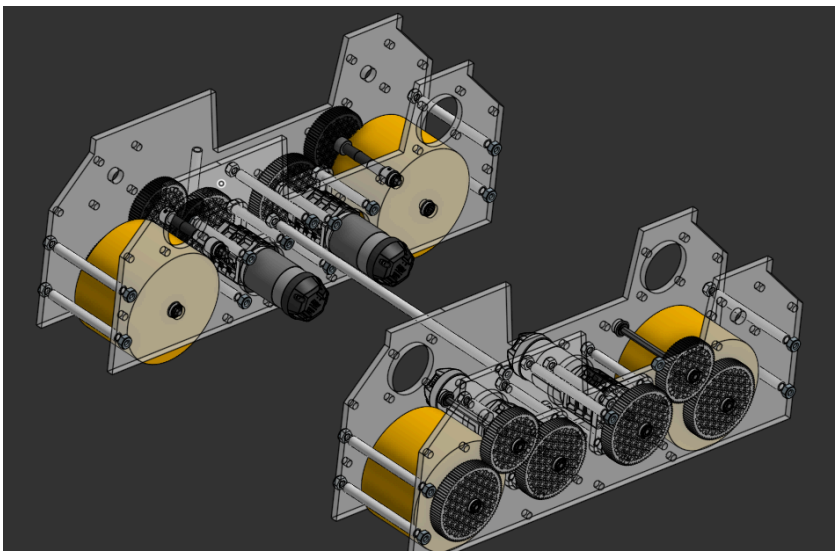


After achieving great success in the Stuttgart scrimmage (we achieved 9th place out of about 20 teams), we came home and instantly began working on a new drivetrain and lifter design.

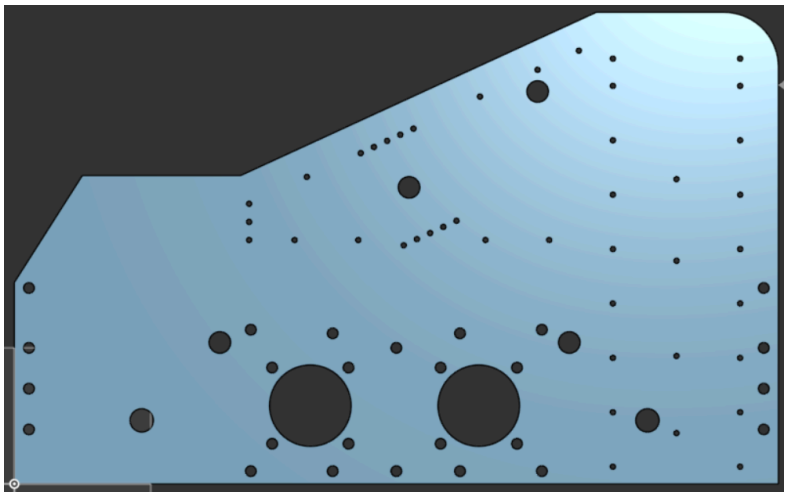
Engineering process:

First drivetrain:

Because of the sheer price of real mecanum wheels, we decided to use 3d printed mecanum wheels. This posed a slight problem, as 3d-printed mecanum wheels are quite a bit larger than real ones, so it made fitting inside the size regulation a bit tricky. But (as always) we persevered and used a “sandwich” type build, which made it so that we had a lot of space above the wheels, allowing us to use said space for other purposes.



Our first design was humble, and the complete robot was indistinguishable from the original concept, but it was a start. Later, we adjusted the side-panels of the robot to better accommodate our lifter and gripper.

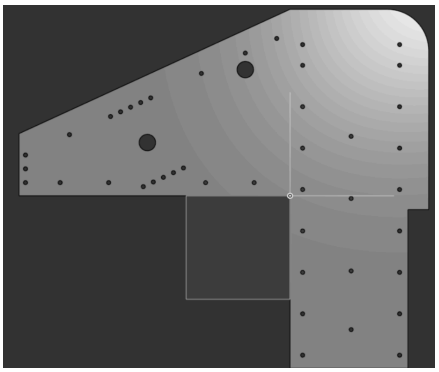


Lifter:

Speaking of our lifter, we decided to use 40cm long linear slides,(the type you'll find in a kitchen drawer) with custom laser-cut mounting panels to accommodate our arm and gripper.

These mounting panels let us mount our motors, as well as our pulleys, which we needed to lift ourselves. The motors are on the inside, while the pulleys are on the outside.

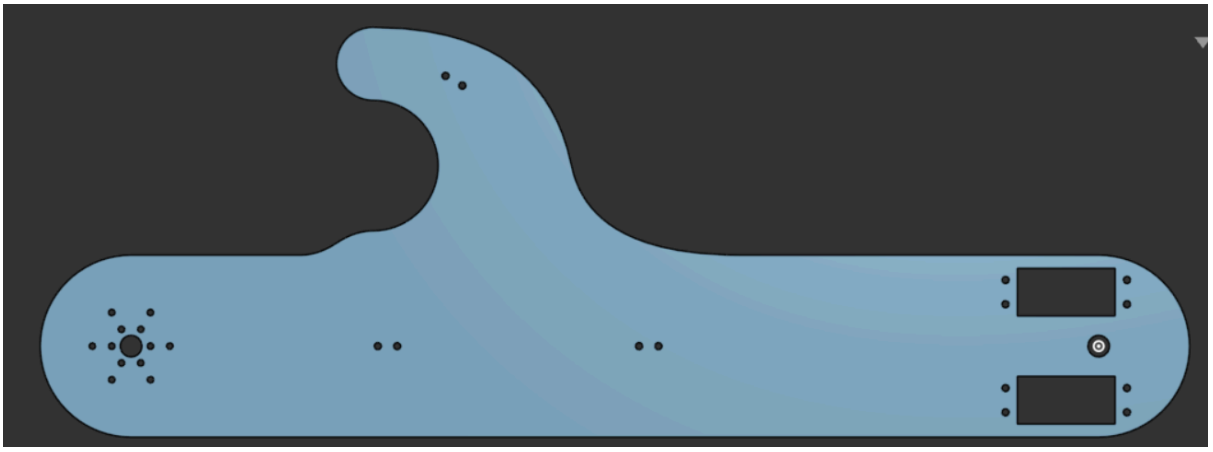
We mounted our arm to a specially made brace which takes away stress from the side panel itself. On this brace we made a massive amount of screw holes, so that we could make sure no matter what, our robot was stable. This turned out to be a great decision, as it was a big help later on.



Arm:

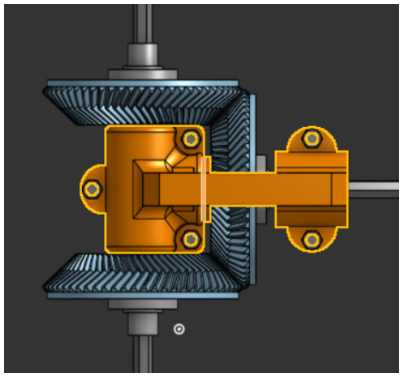
The arm itself + differential:

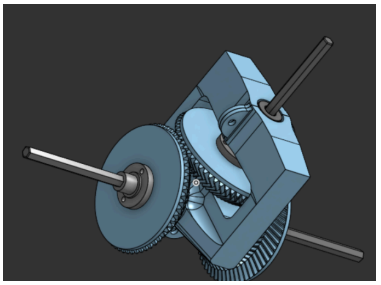
Our arm design went through many phases before we got to our final design. They were all of various lengths, widths, but what they all had in common was the mount for the gripper, which I'll go further into detail on later. Our final design landed us on a plate, with a built in hook, mounting hole for stabilization and for our motors, as well as holes meant for the servos which make up our gripper.



This design allowed us to hook onto the rungs in-game, which would allow us to score extra points. It also gave us the needed length to reach the desired positions.

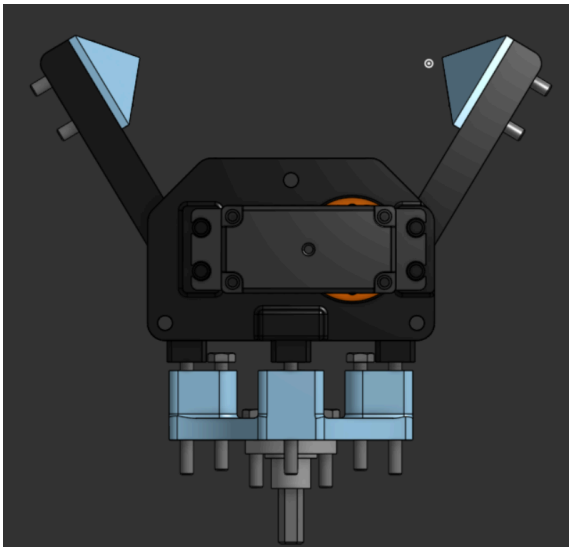
Now our differential is what makes our robot special. We use a unique design, made of various 3d-printed parts and cogs, which allows us to have complete free movement over our gripper. Making use of 2 servo motors mounted on either side, we can use them to either rotate, lift or drop our gripper.





Gripper:

Our gripper incorporates our original design, using 2 pyramid shaped objects to perfectly fit a SAMPLE without it having to be perfectly aligned, as the top of the pyramids fit into the SAMPLE's hole. The open/close mechanism works using a single servo, which rotates the "fingers" of the gripper, allowing us to hold SAMPLE's. Using a shaft, we can easily attach it to our arm, which grants us a greater range of movement.



Code:

Regarding software, we used Java and Android Studio.
We split the code into different files and methods: each for the drivetrain, arm, lifter, differential and claw movement.

For the drivetrain, we are just moving the wheels.

For the lifter, we are using *proportional gain* on the motors. The motors get their mode changed to *RUN_TO_POSITION*, meaning they'll go to the target position after setting the power (which we set to 1).

```
Hardware.lifterLeft.setTargetPosition((int)
Math.round(lifterWantedLocation));

Hardware.lifterLeft.setMode(DcMotor.RunMode.RUN_TO_POSITION);
```

For rotating and tilting the gripper, we are just moving two motors, as explained here.

And for taking SAMPLES with the claw, it was very similar to the gripper, just moving a motor.

Sadly, because of the time limit, we did not have the time to create an autonomous TELEOP for robot.

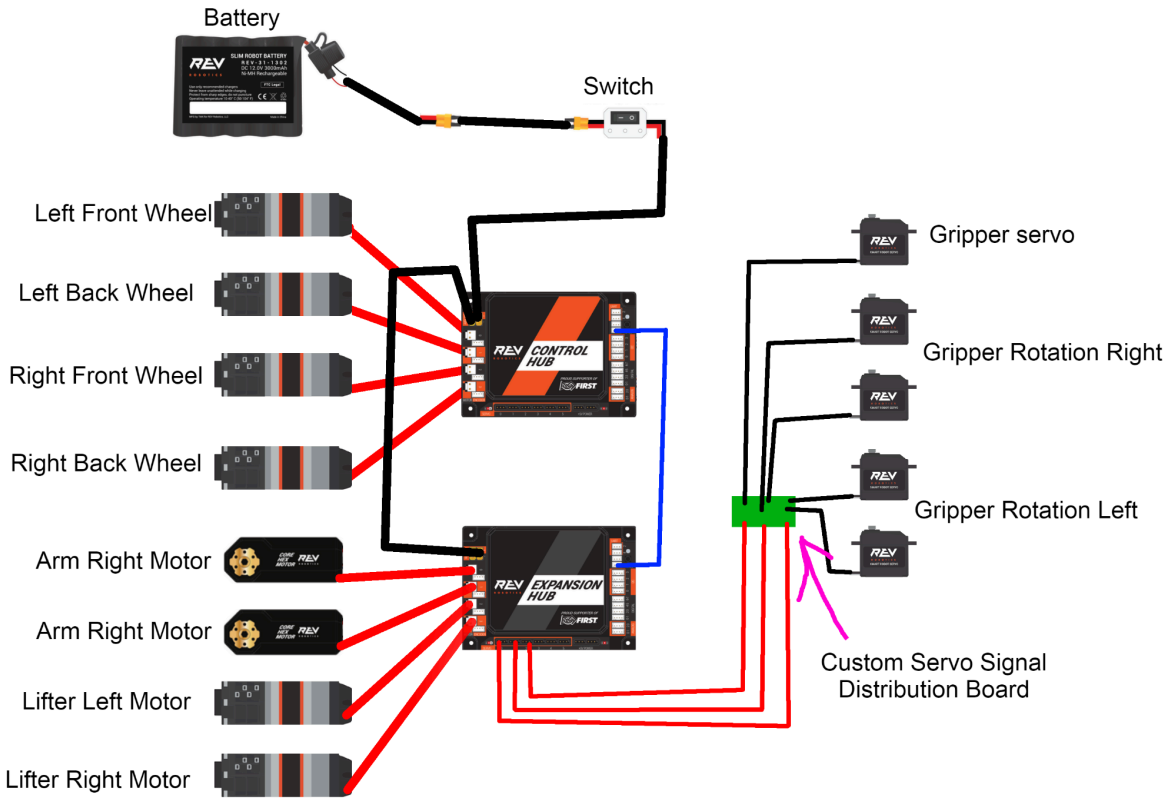
One of the challenges regarding both software and hardware was that when we tried tilting the arm using *RUN_TO_POSITION*, the arm overshot, tried correcting itself, overshot again and that's how we broke one of our two claws (one was a backup). The solution was making a "lunar transmission" (inspired by a planetary reduction gear, modified to only use a single planet), so that the arm would tilt less quickly.

Game Strategy

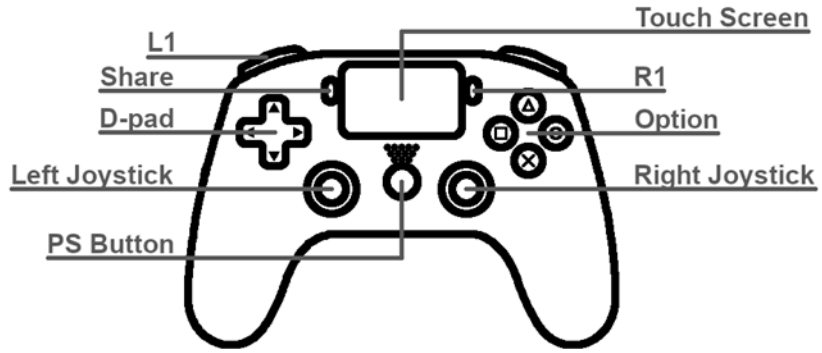
After the first look of the game we decided that we should divide the game into three stages: AUTO, TELEOP and ENDGAME (same as the game itself).
In the autonomous stage our goal was to (if possible) score at least one SAMPLE, and then complete ASCENT onto the LOW RUNG.
In the TELEOP of the game we had two plans. The first was to score as many SPECIMEN as possible. That would include getting SAMPLES from the SUBMERSIBLE to a human player and then when he makes them into SPECIMEN getting them onto CHAMBER.
The second plan was getting SAMPLES into HIGH BASKETS. This would include directly transporting SAMPLES from the SUBMERSIBLE directly into the HIGH BASKET.
With both plans we are versatile so we can adjust to the capabilities of the teams in our ALLIANCE.
Our ENDGAME goal is to finish everything that we did not do in the main stage and ASCENT onto the LOW RUNG.

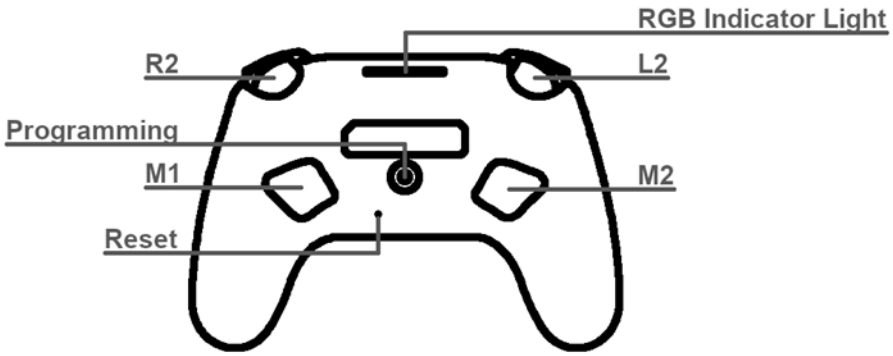
Electrical System

Below is the electrical schematic for our robot. You will notice that we have a CUSTOM CIRCUIT which divides a single servo signal to 2 different servos, allowing us to control more servos while using less cables (allowed by r505).



Control Scheme:





Driver 1:

L1: Arm lift down

R1: Arm lift up

L2: Lifter move down

R2: Lifter move up

R-Stick X: Rotate robot

L-Stick Y: Move forward/backward

L-Stick X: Strafe left/right

X-button: Set arm tilt min

Driver 2:

L1: There to stim to calm nerves

R1: Override min/max limits / when toggled use D-pad up/down to set arm/lifter min

L2: Claw Close

R2: Claw Open

R-Stick X: Gripper rotation

R-Stick Y: Gripper tilt

L-Stick Y: Lifter up/down

L_Stick X: Arm up/down

Outreach

As we are a new team we had a lot to do in terms of publicity. First thing we did was to make an Instagram account. Then we decided that we needed to have a mascot. **Tone** is an olm - or directly from Slovenian, human fish - and it is our mascot. Secondly, we reached out to other teams to arrange some meetings online, but due to the lack of time, we decided that it's best to meet after the competition. We have promoted our team and the sport of robotics at many different events as well, using our experience from both the FGC and FTC to inspire youths in Slovenia to pursue robotics. We presented some of our past robots, from when we and VegaMind were a combined team, at an informative fair, where colleges and highschools promote themselves. We also presented at Information day at our alma mater - Vegova highschool. We also try to keep up appearances on social media, gaining almost 100 followers on Instagram in out first season.