Engineering Notebook

M-MAIS

#23283

Meet the team

Nout Urban - Team Captain, Software Lead, CAD Specialist and Driver

Maria Galagan - PR Manager, Portfolio Lead, Designer and Coach

Enzo Richardson - Hardware Lead, Cassis Specialist, Designer and Driver

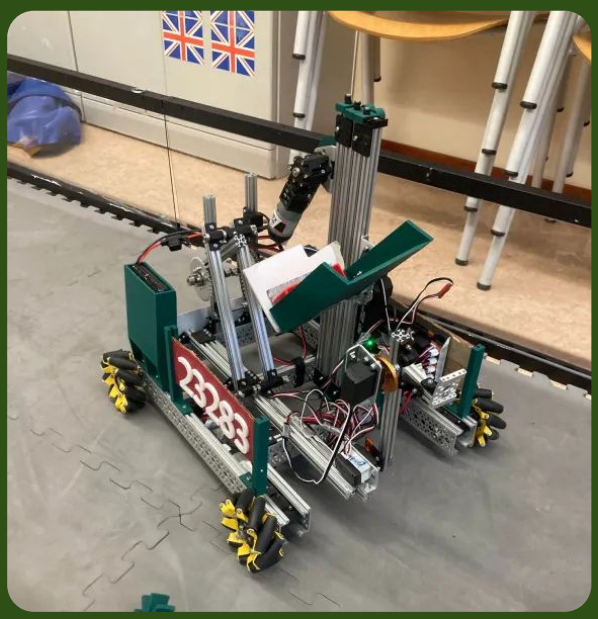
Jasper Geerse - CAD Specialist, Mechanical Engineer and Software Support

David Geleijnse - Software Engineer, Autonomous Specialist and Human Player

Yassine Benhaddou - Mechanical Engineer and Designer

Sander van Geest - Coach

Team **M-Mais** was started in 2023 at Emmauscollege, in **Rotterdam, the Netherlands.** It consists of 6 team members, ages 15-17. M-Mais is a fully **student-led** team, our coach only handling bank statements and communication to our school and parents. This is most members second season, except for one member, its their third season. M-Mais is a play on words of our schools name, Emmaus. Our team's main symbols are **corn cobs, stars**, and our silly mascot, **Pochita**.



Our robot, Mr. Cornbob the Second

As a team we strive to optimize our **individual skills** to the fullest, combining them to form a team that works as one **hivemind**. Our robot lab is considered a **safe space** - apart from us, people outside our team meet to talk about engineering, school and whatever comes to mind. We take pride in **mentoring** our rookie team The Thunders (#21658) who have now learned fromsome of our past mistakes. **Gracious Professionalism** is the number one priority in our team, also outside FTC. For anyone that is reading this Engineering Portfolio, we hope you will be enthralled by reading this :)

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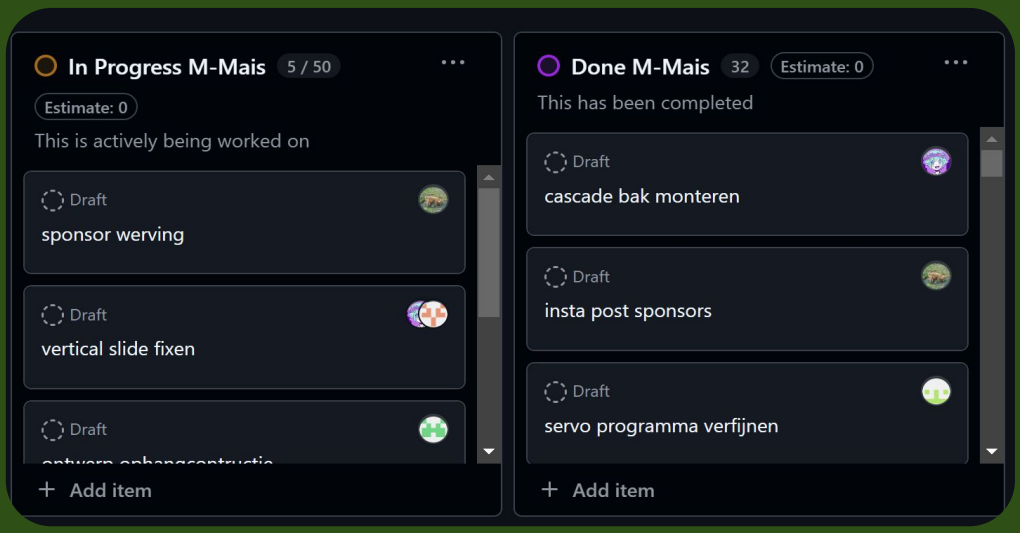
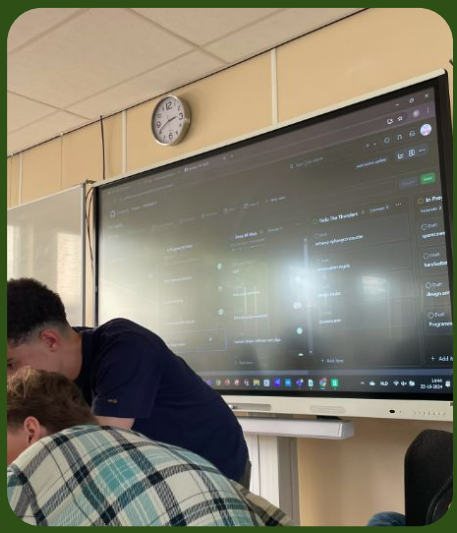
Team plan

Learning from our previous season, we knew a lot of things had to change so we could work more efficiently and create a better robot. Things we wanted to improve on were: **time management, finance and outreach**. Last year our time management wasn't the best, which resulted in a lot of last minute work and changes that did not benefit us. Thus, we wanted to change that and started working with a **Kanban** board, which all members can access through our shared Github repository. Using this method of dividing tasks into To Do, Doing, and Done, we were also able to handle our financial tasks better. This year we are sponsored by **The Robot Engineers,** who's contribution has helped us greatly. With this money we buy robot parts, but also stuff like team merchandise. Undoubtedly we wanted to focus more on outreach this season, as last season we did almost to none. Outreach events proves to be a **positive addition** to our team, acting as both a learning opportunity and team building activities.



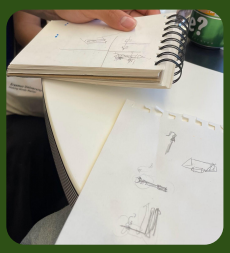


Every Tuesday we have a team meeting with all team members, having everyone be present

Timeline

9 September, Kickoff

At the Kickoff we participated in **masterclasses** and had the opportunity to see the full field.



Also during this time we focused on connecting with **international teams**, as we couldn't do a lot of other outreach events without a robot.

9 November, Scrimmage

At the scrimmage we got to test out our robots first version. We communicated with other teams, learned more about our competition and ourselves during matches.

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In between the scrimmage and the sponsor visit we had our midterm exams, so we could not spend as much time on the robot as we wished. Our robot had not changed much between these two events, but we did have a lot of time to **reflect on our faults**. At the sponsor visit we got a lot of **great feedback from professionals** in the industry which we welcomed with open arms. At Heroes Dutch Comic Con we had two **15 hour days** where we could work on the robot. This benefited us greatly, and we made up for the time we lost during our midterms.

8 December, Qualifier

At the Qualifier we hope to score well on the playing field as well as with the judges. Everyone is really excited and ready to face any challenges that might come our way during and after the Qualifier.

In the time between the Kickoff and the Open House we focused on **designing and prototyping**. We still had a reliable drivetrain from the previous year, which the software team used to program Teleop and test out new features we wanted to utilize. This all happened simultaneously, ensuring everyone had something to work on.

23 October, Open House

At our schools Open House we had the opportunity to build up the full field, which gave us some **driver practice** and the time to think of **game strategies.**

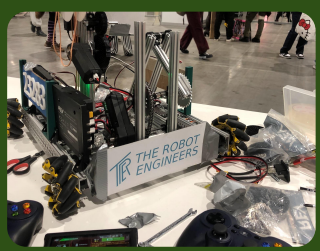
During our matches at the scrimmage we noticed a lot of **faults** in our robot. The main one was our cascade lift, which proved to be challenging all the way up to the Qualifier. On the other hand, we also saw our **strengths**, which was the drivetrain and the intake/outtake system. This left us feeling motivated to improve our robot, knowing we were capable of building working parts.

21 November, Sponsor visit

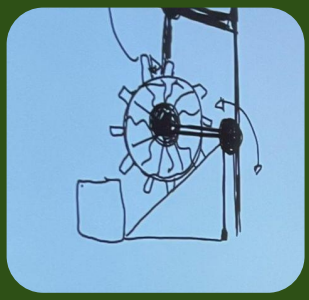
To show our sponsors who we are and what FTC is, we brought them a visit in their office. These **robot engineers** gave us lots of tips.

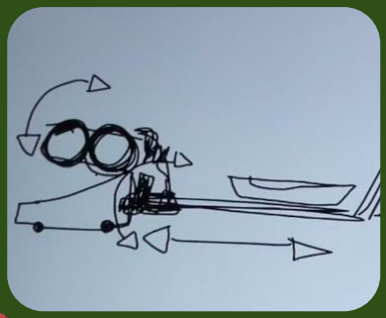
23 + 24 November, HDCC

Heroes Dutch Comic Con was an amazing outreach weekend where we got to work on our robot and have some drivers practice. Killing two birds with one stone.

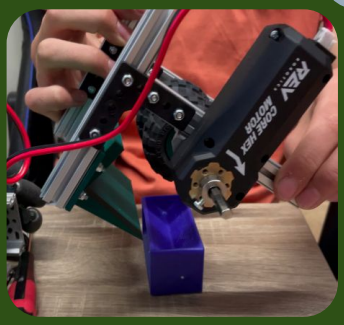


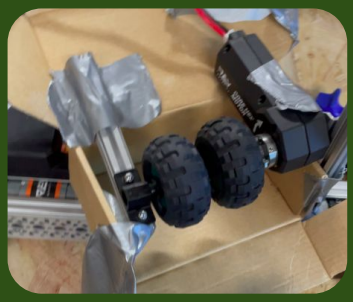
Design process





Before we start designing something, we consider multiple points that make the process easier, such as: **priorities, trade offs, and the use of cost benefit analysis**. Some examples are: the highest basket gives us lots of points, so it is worth it to build a lift that can reach that basket, even if the process is long and challenging. When we analyse a problem we need to solve and keep those points in mind, we start drawing. Drawing usually happens on our digiboard or on paper. We then either build a **prototype** out of materials or immediately design the part in Onshape and 3D-print it to save time. Each subsystem requires a unique approach that we carefully choose.





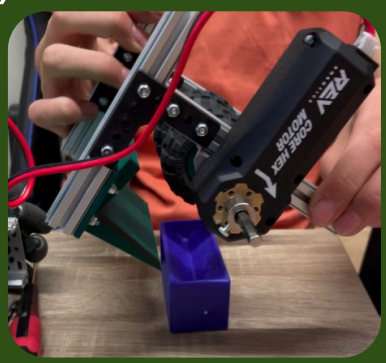
Analyzing this years challenge, we had identified what we wanted our robot to be able to do for the Qualifier. We wanted to stay **realistic** what we could achieve with our time and resources. We settled on scoring samples from the field and submersible into the low and high baskets. To achieve this, our robot needed to be able to:

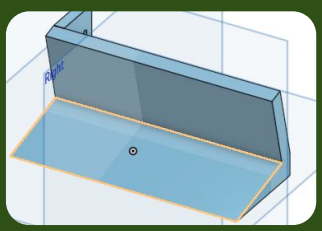
1. Collect samples, from the field and submersible.
2. Transfer samples to a tray connected to a lift.
3. Score samples into baskets

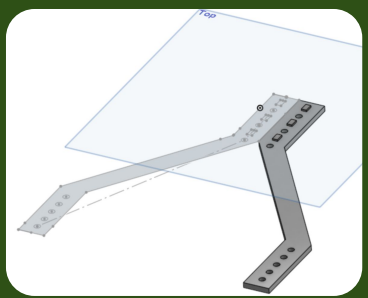
Obviously our robot also needed to be able to drive around fast and smoothly, but as we had achieved that a year ago it wasn't a big challenge for us. Here's how we tackled our new found challenges:

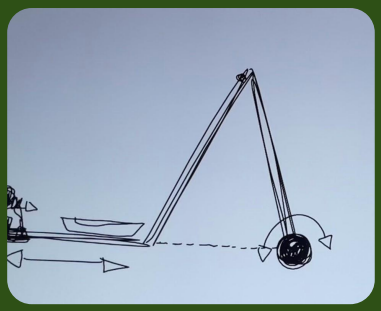
1. Collecting samples -> Intake system & horizontal slider

We wanted to work with an active intake system this season to collect the samples. **Our first prototype** consisted of two lego wheels and a slope, and we would attempt to pull the samples in. After a lot of different designs and troubleshooting, we decided to **move on** as this design would not work for us. It was **unreliable** for a multitude of reasons. For one, the lego wheels would slip of easily, which is not ideal when you want to pick up as many samples as fast as possible. Furthermore, the intake had to be positioned at an **awkward angle** that would not be realistic to recreate with our robot. After this we gained **inspiration** from multiple teams online using a **flipper wheel** to grab the samples. We recreated the design and it was already working better than our previous one. We were working with a Core Hex Motor and a chain at the time, which caused the intake arm to lean to the side, resulting in overall unreliability. More about that later. Our wise friend Igor from team **STT (#3977)** advised us on using a continuous servo instead of a Core Hex Motor. This removed some weight, but added new weight to right next to the flipper wheel. The best solution to this turned out to be to use the chain and continuous servo, this mechanism **balancing** both sides of the intake wrist. Another last change was making the flipper wheel thicker.









To have our intake wrist be able to reach inside the submersible, we decided to build an arm for it, which is a **horizontal slider**. The design is fairly simple and prototyping went smoothly. We first drew what we wanted and then immediately build a **prototype** that worked pretty well with some minor tweaks. We started with a horizontal linear slide that is powered by a Core Hex Motor, connected to a gear and chain. The power pushes the joint, making the slider move forward, helping us grab samples from the submersible.

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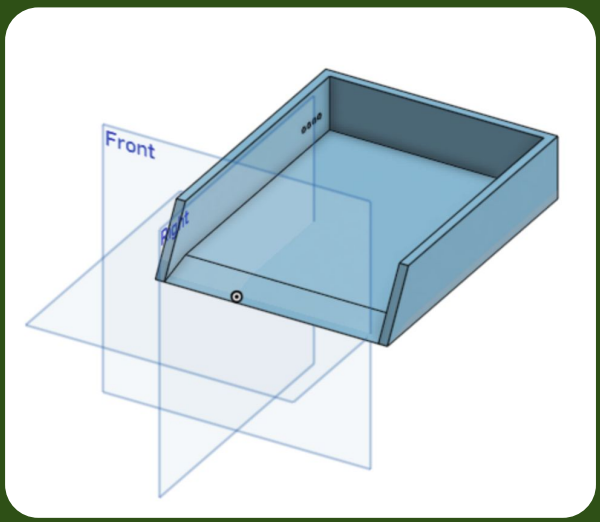
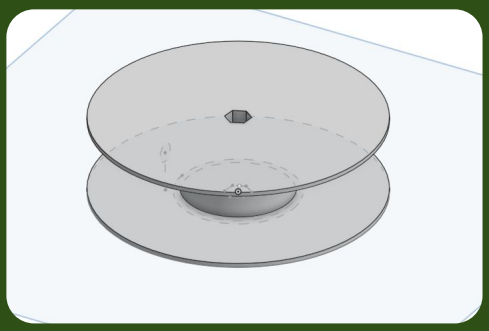
2. Transferring samples to tray -> Outtake & lift tray

Now that the intake was finished and almost near perfect, we needed the ability to **dispense the sample** as well. Simultaneously we were working on our cascade lift, but we also needed to make the bridge between that and the intake. For that we **designed and 3D-printed** a tray that we titled the lift tray, as it is part of the lift. The lift tray has three set positions that ensures the sample won't fall and will be dispensed into the basket timely. The intake wrist is connected to a servo that can move 180 degrees, thus being able to bring the sample to the lift tray. Then the servo turns the other way to slowly but surely transfer the sample. A lot of this was **trial and error** with positioning the flipper wheel at the right place, but we have gotten the hang of it.

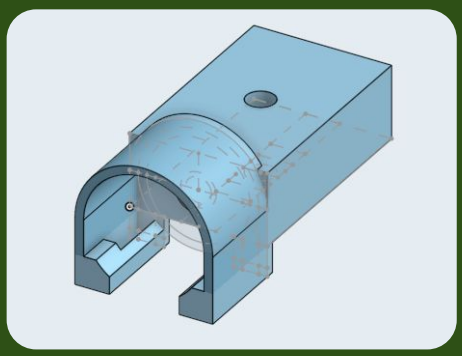


3. Scoring samples into baskets -> cascade lift

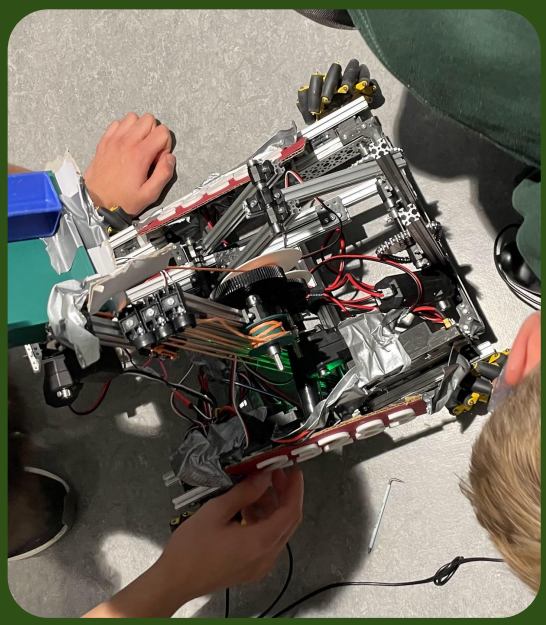
To score the samples into the baskets we use a **cascade lift**. The lift tray is attached at the very top. The rest of the lift works with a rope and a pulley. This proved to be our **biggest challenge**, as the rope has a mind of its own and would be too loose and get stuck in the gears. We mainly noticed this issue in the scrimmage we attended, only being able to raise our lift once or if we were lucky twice per match. So, there was a lot of work to be done. We **redesigned** our pulley by increasing the outside diameter so the rope wouldn't wander off. The next issue we had was the tension being to high, resulting in the pulley covers popping off at random times, messing up the entire system. For this we **innovated** new and improvement pulley covers that would not snap off, but also keep the rope in place. The next encountered issue was that now the **friction** was too high, so we swapped our Hex Core Motor for a HD Hex Motor. This also resulted in our lift moving faster up. But it did not go down yet. We tried adding another parallel rope that would pull the lift down, but the same problems as before occurred. So we resolved the issue with adding extra weight in the shape of an old broken motor, therefore fighting the friction. To keep the lift as frictionless as possible we use WD40. And although the lift works as intended, some of our homemade pulley covers still tend to snap under high tension. This is something we plan to **improve on in the future**, by experimenting with other types of sliders that have less friction.



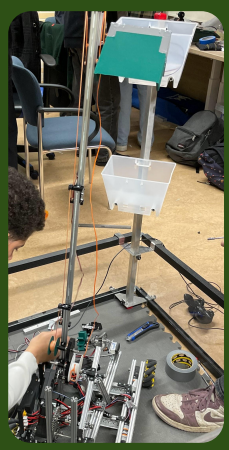
Pulley with increased diameter



New and improved pulley cover



After the Qualifiers we are planning to design a **hanging system**, so we can be able to perform ascent during endgame. Despite our robot now working fine, we will never stop **evolving** it as there are always things to better. For example, our **cable management** is currently not the best. This and more issues are priority number 1 once we get back to the robot lab.

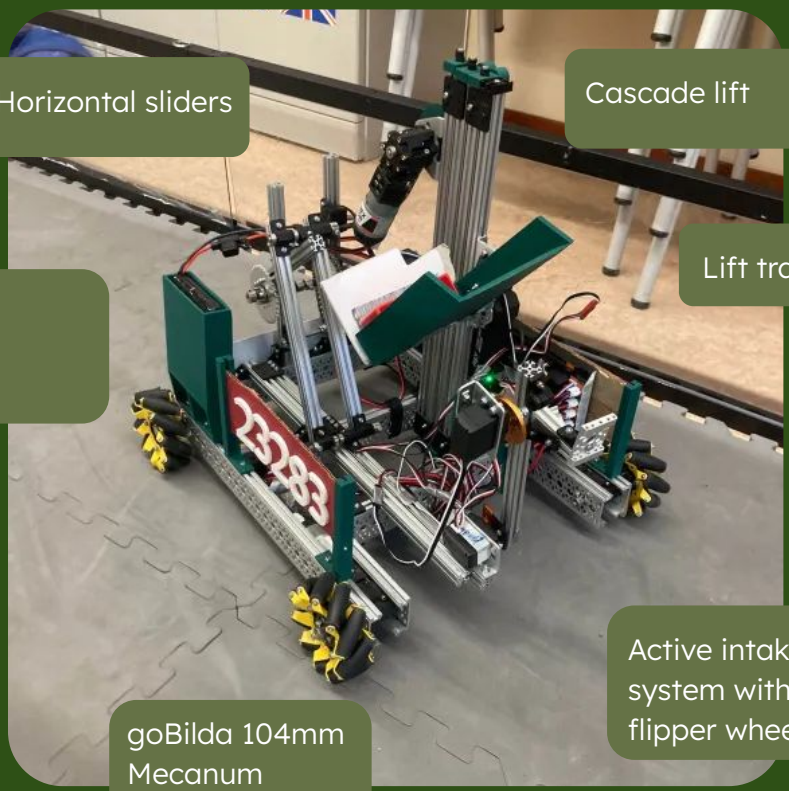


Robot overview

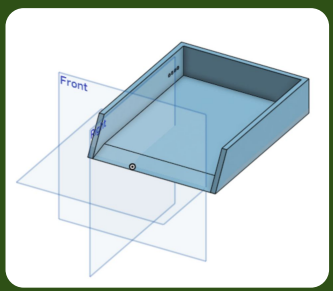
Mr. Cornbob the Second

Horizontal sliders

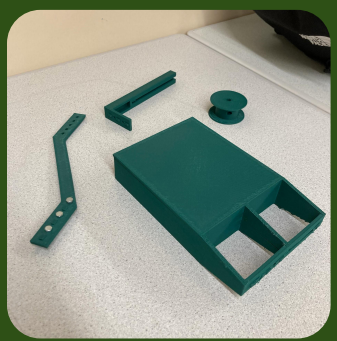
Cascade lift



Lift tray



Various 3D-printed accessories to make organization easier



Active intake system with a flipper wheel

goBilda 104mm Mecanum wheels

Software

We control the robot with two gamepads, one for the **drivetrain** and **cascade lift,** the other for the intake. Next, let's talk about the movable arms, sliders, cascade lift, and more. Gamepad 2 controls almost all of these features, so gamepad 1 can **focus** on **driving fast** and **precisely**. Driver 2 is responsible for moving the **horizontal slider** forward and backward, as well as controlling the pole at the front of the slider. This pole is part of the **intake system**, which can suck in blocks and spit them out when needed. Additionally, driver 2 can raise the container of the **cascade lif**t and rotate it to allow the sample to drop into the container. Pressing multiple buttons in an exact order can be very difficult, so we added **combo buttons** that perform those actions automatically. We also moved the buttons for the cascade lift to driver 1's side to **reduce stress** on driver 2. Regarding the combo buttons, when driver 1 moves the lift up, the lift container **automatically adjusts its angle** to prevent the samples from falling out. The same happens when the lift moves down, ensuring the lift container **doesn't get caught** on the basket.

This year our goal for **autonomous** isn't that different from teleop : score as many samples as possible in the high basket. We tried using **functions** that would execute for certain periods of time, e.g. drive forward for 5 seconds, or lift arm for 2 seconds. This would prove to be relatively easy to program. However, it **wasn't reliable** and consistent at all. The robot moves further at one time than at another, due to the varying battery levels. Realising this would not work, we tried using **IMU**, the internal measurement unit, to read to robots orientation. This also proved to be inaccurate. Now our plan is to use a combination of color/distance sensors, imu and the timed functions to achieve success in the autonomous period.

For the future we want to use more **sensor inputs**, so we can have a more **reliable autonomous**. This will get us more points and a good head start. The ideal situation would be if we could configure **Roadrunner**, but what we've learned from other teams is that it takes a long time and we realistically know we probably won't be able to reach that goals, but it is definitely a goal we would like to achieve next season.

Outreach

Our first outreach event of the season was the **Open House** day at our school. Here we got to showcase the First Tech Challenge, but also **STEAM** activities. A lot of kids and parents were interested in the robot, software or 3D-printer. With this event we not only recruited more people for future robotics season, but we also **peaked people's interest** in engineering. We got a lot of positive feedback from kids, parents and our own teachers. It was a productive day where we also got to work on our robot.

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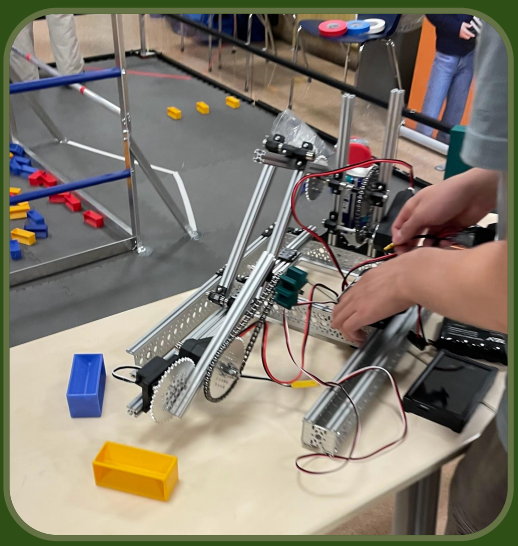

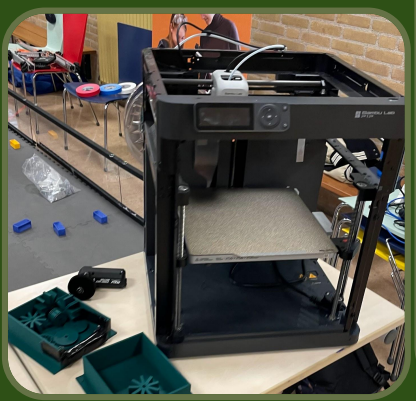

Our second outreach event was a visit to a **primary school** organised by our rookie team The Thunder (#21658) At this visit we gave 11-12 year olds three **workshops** all related to robotics and STEAM. The workshops were: programming, designing and building. Each of these workshops reflected something we do for FTC, and the kids enjoyed it greatly and all learned something new about themselves and their **capabilities**.

In the weeks following we brought a visit to our **sponsors, The Robot Engineers**. We gave them a presentation on FIRST and FTC specifically, explaining this years challenge and limitations. We also gave them a demo of our robot, which they found very interesting. This visit was right after the scrimmage, so they helped us brainstorm a little on possible **solutions** to problems we were facing. We also got to see their **workspace**, and how people in society can **benefit** from robotics. Their workplaces were really cool to see for us, as we saw a lot of what we did come back in their practices. We still keep in **close contact** with them and invite them to events and share photos/videos.

Our by far most fun outreach event this year was **Heroes Dutch Comic Con**. We got to man our own **stand**, where we set up the field, had a working space and a 3D-printer. This event allowed us to do so much, such as: showcase robotics and FTC to a wide variety of people, work on our robot for full days, and even have some driver practice. This weekend was full of **excitement** of talking to people who were interested in our robot. It was also a good team building experience, as we got to wander around Comic Con together and see our interests come to light. We also had the opportunity to host a panel, where we gave a **presentation** on robotics in the Netherlands and how to get started with it. We had quite the audience and a lot of people had questions about the topic.

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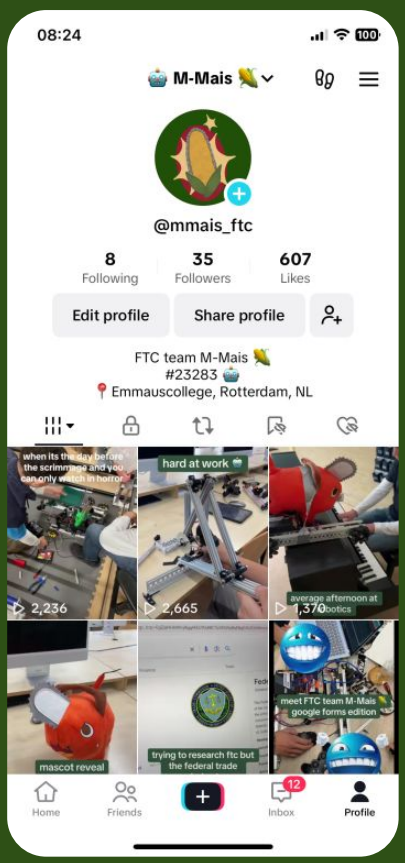
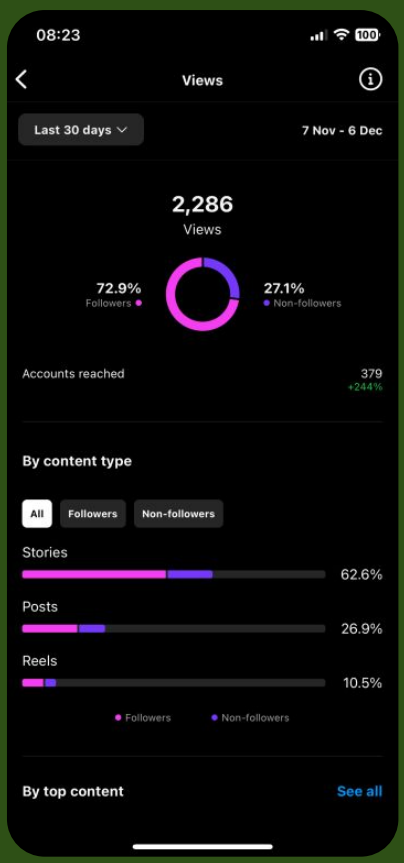
The next weekend we went to a Ukrainian Saturday school in The Hague, **Ukrainian school Wesselka**. Here we showed a demo of our almost complete robot to students **aged 3-15**. Once again there was a wide variety of children, some being born here and some being forced to evacuate their country due to Russia's full scale invasion in 2022. The kids had a lot of **fun** high-fiving the robot, feeding him samples and watching him dance. It was a nice distraction from their regular lessons, where they learned something and got their **interest peaked** in engineering.

We find **connecting** with other teams very important, and so we also make sure to make time for that. Internationally, we have spoken to **Tennessine Titans (#21457)** from the USA and **XMachine (#17801)** from Brazil. Other than that, me also have connections with teams that compete in the Benelux, such as **Robotic Tech Frox (#20092), STA (#13953) and in peculiar STT (#3977)**. We often talk about our robots progression and exchange tips. They have helped us out and we want to thank them for that! Additionally there was a **mini scrimmage hosted** at our school with them, right before the Qualifiers.

Along with that, we are also very active on **social media platforms** such as **Instagram and Tiktok**. This way we can connect with a lot of teams and reach even more people outside of FTC.





@mmais_ftc on TikTok and Instagram!