Engineering Notebook

7925X

Team Number

EX NIHILO

Team Name

Hangzhou No.2 Highschool

School

10/02/2024	20/04/2024	2 of 2
Start Date	End Date	Book #

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VEX ROBOTICS

REC FOUNDATION

CONTENTS

7925X

Part I ASIA OPEN SUMMARY

- >Part I:ASIA OPEN SUMMARY
- >>STRUCTURE
- >>>INTAKE
- *Due to the shortage of motors during Asia Open, we used 5.5W motors to drive the intake wheels. However, we can only use smaller radius rubber wheels, which can easily lead to insufficient intake wheels and losing the ball during the competition. At the same time, the rubber wheel will accumulate dust after use for a period of time, causing a decrease in friction and requiring regular cleaning. Instead, After Asia Open, we found that this design can smoothly compete in most cases, and the structure is small and convenient. We are considering continuing to use it in the next generation of robot.*
- >>>SIDE ELEVATION
- *Our previous generation of robot were equipped with two elevation arms, connected them by ropes and driven by a cylinder, which can open and close smoothly when the air pressure in the cylinder is high enough. We installed two elevation arms on the side of the robot directly, that means this will not affect other structures during the unfolding. In order to increase its stability, we use pillars and PC boards at the end of the arm to better grip the robots on the pole. This way, the robot can be elevated from two angles, increasing flexibility.*

- >Part I:ASIA OPEN SUMMARY
- >>STRUCTURE
- >>>SIDE ELEVATION
- *However, on the one hand, due to the limited tension of the rope, it is easy to break and difficult to repair. What's more, when the gas tank pressure is low, there may be situations where it cannot be directly retracted. Gas tanks have to be placed vertically, so the structure is complex. In the competition, we found that many teams can use high poles for D-tier or even E-tier elevation, while A-tier elevation appears relatively weak. At the same time, high-level elevation in skill competitions brings high profits. Therefore, we are considering improving the side elevation to enhance the height.*
- >>>HIGH ELEVATION
- *Due to our consideration of the need for assault capability on the field and the need for a catapult, as well as having certain goals for Skills, and considering a maximum motors' power of 88W, we have chosen to use a small motor with a speed of 200 rpm to drive the high elevation. This can save the motor power for the catapult that requires greater power. But because of the motor provided smaller power, we need to use gears to reduce the speed of high elevation. We let the small motor drive the 12T gear, and then drive the 60T gear.*

- >Part I:ASIA OPEN SUMMARY
- >>STRUCTURE
- >>>HIGH ELEVATION
- *This structure was repeated twice to achieve a 1/25 speed effect. When the power is constant, reducing the speed leads to greatly increases of the traction force. So that the robot has enough power to elevate. But it also leads to a slower arm folding and unfolding speed. We used the most easily assembled rubber band for high elevation power. To pursue a C-tier elevation, it is necessary to consider the barycenter of the robot, otherwise it is easy to shake back and forth after elevating, resulting in a lower actual height. Therefore, we are considering how to effectively improve the height of high elevation under the same time consumption.*
- >>>CATAPULT
- *In Asia Open, we used a red motor to throw balls, and a speed of 70 has a great advantage in the Skills. After multiple rounds of debugging, we have built a platform with a PC board that performs well, allowing the balls to be thrown at a basic angle during import and controlling the landing point. However, during use, plastic teeth wear rapidly and require regular replacement, while structural maintenance is difficult. Overall, this is a relatively good design, and we are considering continuing to use it.*

- **>Part I:ASIA OPEN SUMMARY**
- **>>STRATEGY**
- **>>>QUALIFICATION**
- *Considering that our teammates and opponents are not overly concentrated in the Qualification, so we have arranged our own main strategy of single defense and single attack:*
- *If the teammate's strength is average, just let them mainly defend the weak channel on the left side, and we throw four balls for one time while the opponent is defending, cooperate with the teammate to receive balls. At the same time, use channel attack strategy during competition's open.*
- *If our teammates are strong enough, we will mainly play on the left side defense, but still not give up our attack opportunities to push the channel's tri-balls, and catch our teammates' tri-balls well.*
- *Sometimes the opponent can defend well, which may leads us to make a few mistakes. When grasping the timing of the channel strategy, there will may be some judgment mistakes, resulting in the channel being intercepted. Of course, after discussion through operator and loader, we have also made certain tactical modifications.*

- >Part I:ASIA OPEN SUMMARY
- >>STRATEGY
- >>>QUALIFICATION
- *As a robot with catapult, we can directly throw tri-balls because the defense difficulty of throwing tri-balls is indeed high. In addition, our teammates' defense performance is also very good, and they can basically defend the channel stably. So actually we don't have much pressure from frontal attacks when throwing tri-balls.*
- >>>STRATEGY
- *In Qualifications, where the intensity isn't very high, so you can choose to push the tri-balls directly instead of throwing tri-balls. After all, throwing tribals cannot guarantee that you can successfully score most of the time. Therefore, in terms of strategy designing, we need to further study the timing and priority of throwing tri-balls and push channels. When throwing tri-balls, one must pay attention to which direction to hit and which path to follow to achieve a high success rate. The channel must seize conservative opportunities to fight:*
- *Symmetrically hit the opposite side, and when crossing the long barrier on the opposite side, back and import for 2-3 tri-balls to import.*

- >Part I:ASIA OPEN SUMMARY
- >>STRATEGY
- >>>STRATEGY
- *Take a channel free on the opposite side, and when the opposite side is in our triangular area, hold their robot and import 2-3 tri-balls.*
- *Seize the opportunity when facing off in the opposite channel*
- *In the Finals, it is more important to utilize the tacit cooperation with teammates and try to play a dual channel attack. More importantly, when using catapult tactics, pay attention to direct coordination with retreating players to avoid being blocked by a whole wave at once and wasting filling.*
- >>TRIBALLS LOADING
- *In Qualifications, as a Importer, he or she usually acts as the "second pair of eyes of the operator" to help the operator master information outside and inside the field more clearly. For example, in the competition, when our opponent runs to help their teammates defend or when the opponent has one or two tri-balls before the box, Importer will tell the operator that the channel is empty, and then we can import 3-4 tri-balls to quickly score. When our left teammate doesn't defend and goes on attack, which out of our plan.*

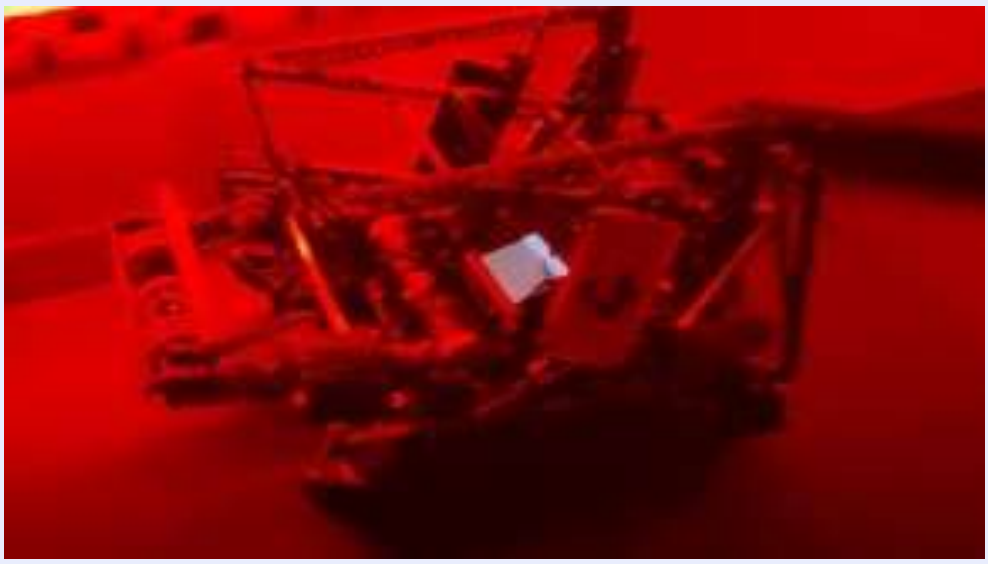
- >Part I:ASIA OPEN SUMMARY
- >>TRIBALLS LOADING
- *Importer also have to tell the Operator to quickly supplement the defense. At the end of the competition, Importer also need to help the Operator report the time and remind them to elevate. In addition, we also need to inform the operator how many more triballs are left in the frame to avoid wasting time when there are no more triballs in the frame but the operator is unaware of the specific situation and drives the robot to the import area to try to guide multiple triballs.*
- >>SKILLS
- *In Skills, Asia Open, we didn't do well in both the automatic and driver stages of catapult, and there were also significant issues with Importer's personal act. The main factor is that Importer couldn't catch the triballs during the importing, and he always let go of it, resulting in an empty racket and affecting the overall triballs-throwing efficiency. This may be because the temperature inside the venue is relatively low and he only used to wearing short sleeved throwing triballs, so his hands are particularly icy and he cannot catch the ball. Secondly, because one time during the throwing of triballs, the box and chair were not properly placed, causing the box to fall backwards during the throwing of triballs.*

Part II WORLD CHAMPIONSHIP
STRUCTURAL IDEAS DESIGN

- **>Part II:WORLD CHAMPIONSHIP:STRUCTURAL IDEAS DESIGN**
- *Firstly, we will refer to other teams with higher rankings in the world to find the ideas for our World Championship Robot.*
- **>>SKILLS RANK**

Team No.	2029C
Skills Rank	#2
Design Feature	1. Use a two-stage foldable robotic arm to elevate at the top of the vertical elevation bar, and then elevate to G-tier. At the same time, the body is lightweight and has fast triballs pushing and tracking capabilities 2. Wing on the left front side of the robot, which cannot pass through the center barrier. When pushing the triball in the channel, multiple triballs can be inserted and mistakes can be minimized as much as possible 3. The foldable intake can replace elevate the intake structure to retract the car, while folding the intake can cushion the impact force of the robot's intake part and protect it 4. Two wings at the back of the robot, which can hook out the triballs left in the triangle area during the competition
Resources Link	https://www.youtube.com/watch?v=YopkZXqMK1c

- >Part II:WORLD CHAMPIONSHIP:STRUCTURAL IDEAS DESIGN

Summary	1. In the game, the main scoring method will be more to use channel strategy to push multiple triballs, and in addition, the robot also has the ability to quickly clean up teammates' throwing triballs in front of the opponent's goal. 2. Press the time to elevate at the end of the game, and the G-tier elevating will also become an important factor for robot to win. But while elevating, the robot lost the chance to make up for the last wave of attack 3. After rapid using catapult and channel push strategy, the game may get stuck in a situation where there are no extra triballs. At this point, the wings can handle the triballs that is being defended into the triangle area, increasing the chances of scoring
Photo	

- >Part II:WORLD CHAMPIONSHIP:STRUCTURAL IDEAS DESIGN

Team No.	229V
Skills Rank	#3
Design Feature	1. The robot has two front wings that can quickly clean up triballs thrown by teammates in front of the goal during the competition. In terms of channel entry, the two wings are more flexible, allowing for both left and left channel entry 2. The robot has two rear wings that can hook out triballs remaining in the triangle area 3. The robot has the ability to throw triballs, with a fast throwing speed and the ability to quickly throw multiple triballs 4. Using a small motor for high elevate, it has the function of C-tier elevation directly
Resources Link	https://www.youtube.com/watch?v=s7yU7V1xgsw

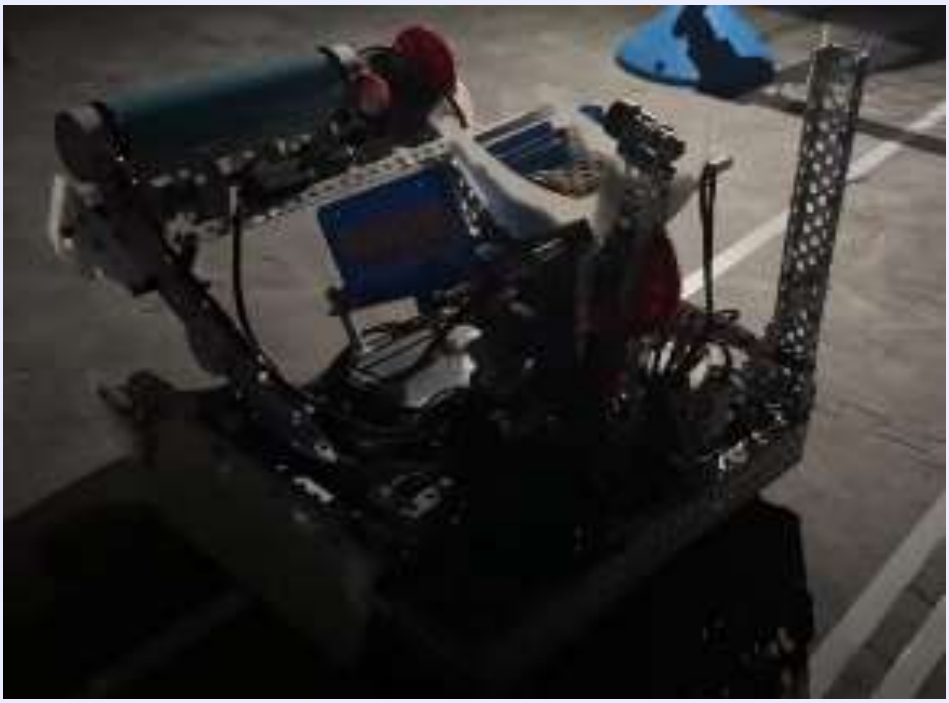
- >Part II:WORLD CHAMPIONSHIP:STRUCTURAL IDEAS DESIGN

Summary	1. In the competition, robot have multiple attack modes, and it can import multiple triballs in any empty channel. At the same time, it is also possible to break the scoring drought by throwing triballs to allow teammates to make up for the triballs in games with high defensive intensity 2. After rapid using catapult and channel push strategy, the game may get stuck in a situation where there are no extra triballs. At this point, the wings can handle the triballs that is being defended into the triangle area, increasing the chances of scoring 3. The robot can stably elevate during the game, but in the final time period, the robot needs to suppress the time to elevate, losing the opportunity to push a few more triballs in the final time period or make a final attack with triballs.
Photo	

- >Part II:WORLD CHAMPIONSHIP:STRUCTURAL IDEAS DESIGN

Team No.	99904B
Skills Rank	#4
Design Feature	1. The robot has two wings, both of which are slanted and do not have the ability to cross the barrier, but can be more flexible to import through any channel. 2. Narrow. The size of the wings is designed to be just enough to pass through the channel with wings open, and the width of the double-sided wings is also larger, which has a stronger ability to quickly clean the triballs in front of the goal 3 16.5W clutched motor is used for both high elevation and catapult, using a rope pulling method for high elevation, with a simple structure and have a fast speed 4. The robot has a double-layer intake structure, which can use the upper roller of the intake to take the opposite roller in the opposite direction, and then use the lower roller to grab opponent's triballs

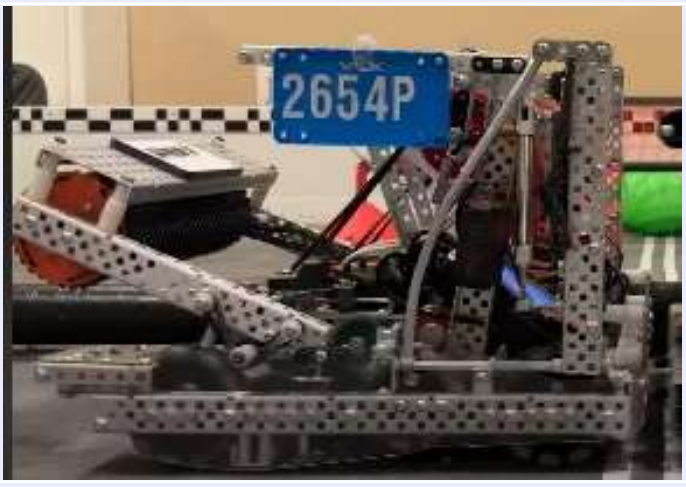
- >Part II:WORLD CHAMPIONSHIP:STRUCTURAL IDEAS DESIGN

Summary	1. In the competition, robot have multiple attack modes, and it can import multiple triballs in any empty channel. At the same time, it is also possible to break the scoring drought by throwing triballs to allow teammates to make up for the triballs in games with high defensive intensity 2. When the robot is playing one-on-one on the defensive side, it can use a double-layer intake to grab the triball from the opponent's possession, greatly limiting their single triball attacking ability 3. Through the clutch, a large motor can be used for high elevation, so the machine's high elevation speed will be faster, so the robot may push the triball during the final time period and then quickly elevate.
Photo	
Resources Link	https://www.youtube.com/watch?v=q7oh9nQd1Ds

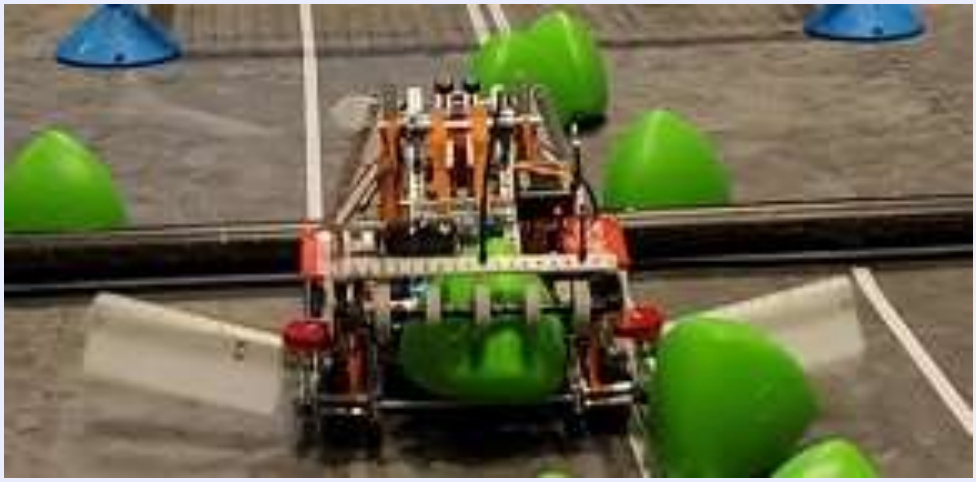
- >Part II:WORLD CHAMPIONSHIP:STRUCTURAL IDEAS DESIGN

Team No.	2654P
Skills Rank	#5
Design Feature	1. 36:60 transmission, blue motor, 66W 360RPM chassis; The import part uses a 600RPM 11W power motor. The chassis has a quick release grip structure that can reduce displacement when the robot is impacted, but it seems to violate competition rules and is not very practical. The robot has a butt shovel behind it, which can prevent the opponent from importing. In addition, the robot only has the ability to cross a single barrier, and its ability to chase and defend through a channel will be slightly slower than directly crossing the barrier with its back side 2. Designed a mechanical arm with anti-catapult structure, which can extend to block opponents when they are throwing triballs;A catapult channel with reverse defense against anti-catapult structures 3. Has an ultra fast pneumatic C-tier elevation function 4. Equipped with double wings that can be used to hook out triballs in the triangular area

- >Part II:WORLD CHAMPIONSHIP:STRUCTURAL IDEAS DESIGN

Summary	1. The strong grip structure of the robot can enhance adversarial ability, allowing the robot to block opponents even when its own adversarial ability is not strong. However, the strong grip structure of the robot may damage the field and violate competition rules, so the opportunity to use it is actually very limited 2. The anti-catapult structure of the robot can effectively organize the opponent's robots' throwing and subsequent scoring in competition where the opponent use catapult without thinking, disrupting the opponent's attacking. 3. The robot can quickly pneumatic C-tier elevation, so in the final time period, the robot can import few triballs and then elevate in second time 4. After rapid using catapult and channel push strategy, the game may get stuck in a situation where there are no extra triballs. At this point, the wings can handle the triballs that is being defended into the triangle area, increasing the chances of scoring
Photo	
Resources Link	https://www.youtube.com/watch?v=PnFpyDUVZr8

- >Part II:WORLD CHAMPIONSHIP:STRUCTURAL IDEAS DESIGN

Team No.	66475C
Skills Rank	#8
Design Feature	1.Four wings. The first two wings are of the same size and do not have the ability to cross the barrier. However, in terms of import, the machine can be more flexible in channel import. The last two wings can hook out the ball in the triangle area, increasing scoring opportunities
Summary	1. Low robot chassis and low center of gravity, and there will be no problems such as bounce the intake part after quick start
Photo	
Resources Link	https://www.youtube.com/watch?v=V5TJhACrsk8

- >Part II:WORLD CHAMPIONSHIP:STRUCTURAL IDEAS DESIGN

Team No.	78792E
Skills Rank	#7
Design Feature	1.Ultra wide triballs holding port, which can reduce the damage to the triball in front of the robot's intake when multiple triballs are imported into the channel 2. Super large PC board, as a strong catapult with anti-catapult function. The overall curvature of the triball thrown will be higher, making it less likely to be defended by opponents 3.Two front wings, neither of which can cross the barrier. It also has the ability to quickly clean the triball in front of the goal, which can increase the efficiency of catapult
Resources Link	https://www.youtube.com/watch?v=4ziGc-XqA-I

- >Part II:WORLD CHAMPIONSHIP:STRUCTURAL IDEAS DESIGN

Summary	1.Multiple attack methods, which can be used for channel entry or throwing triballs when the defense intensity is high and the pace of the game is declining to accelerate the pace of the competition, making it difficult for the opponent to cope for a while 2. The anti-catapult structure of the robot can effectively organize the opponent's robots' throwing and subsequent scoring in competition where the opponent use catapult without thinking, disrupting the opponent's attacking. 3. The robot can import few triballs and then elevate in second time.
Photo	

- >Part II:WORLD CHAMPIONSHIP:STRUCTURAL IDEAS DESIGN

Team No.	2496Y
Skills Rank	#6
Design Feature	1. 5.5W motor lifting arm, clutch chassis elevate
Resources Link	https://www.youtube.com/watch?v=OWEsaoWHXvQ
Team No.	16868K
Skills Rank	#9
Design Feature	1. Equipped with a small motor gear reduction C-tier, and the elevation speed is relatively slow. In the final period of the competition, the robot needs to schedule the time for high elevation, otherwise there may be a situation where there is no enough time 2. Roller throwing device. and the upper limit of throwing speed and efficiency depends on the efficiency of the Importer in the team 3. The width of the robot's intake holding port is large, which can better protect the incoming triball from being damaged by defensive robots 4.If robot was equipped with Double barrier-passage structure, it can makes it faster to supplement defense. However, 16868K robot does not have one. Its ability to damage and import triballs is relatively poor. 5.Two wings, both of the same size and without the ability to cross the barrier, but in terms of import, it can be more flexible in channel import.

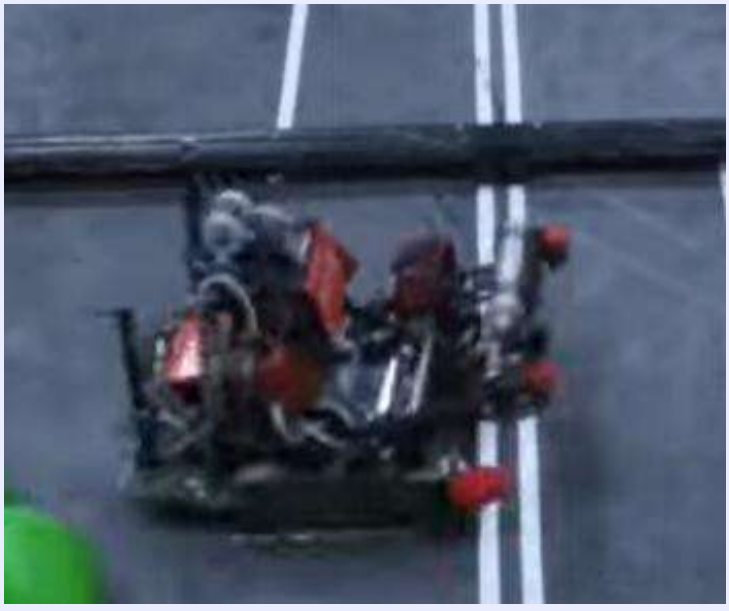
- >Part II:WORLD CHAMPIONSHIP:STRUCTURAL IDEAS DESIGN

Summary	1. There will be more options for the robot to import though channels, as the robot's two wings allow itself to expand the corresponding edges in each channel, and the wings can import more stably 2. Roller throwing device, which can quickly throw triballs but may not be used too many times, because Roller device throwing requires higher ability of the Importer to place the triball in the designated position and the speed of releasing the triball. Otherwise, the landing point of the ball will be extremely unstable. But this kind of unpredictable point can also surprise the team player in certain situations 3. In the defensive phase, the robot's adversarial ability will decrease due to the lack of a shovel, and its ability to fight against the defensive team will not be high
Photo	
Resources Link	https://www.youtube.com/watch?v=A5RBaGG2z3w

- >Part II:WORLD CHAMPIONSHIP:STRUCTURAL IDEAS DESIGN
- >>TRUESKILL RANK

Team No.	21417A
Skills Rank	#55
Design Feature	1. The chassis can double cross the barrier, which can accelerate the speed of the robot's defense against enemies' imports. However, it is not equipped with a shovel, so its ability to resist and track damage to imports in the channel will be much worse 2. Four wings, and the first two wings are of the same size and do not have the ability to cross the barrier. However, in terms of import, the robot can be more flexible in channel import. The last two wings can hook out the triballs in the triangle area, increasing scoring opportunities 3. The triball throwing structure of the robot is a roller throwing device, but compared to single roller throwing, is uses double roller wheel, which will be more stable and accurate in the triball's throwing point. But the efficiency of throwing mainly depends on the Importer's speed 4. Pneumatic C-tier elevation , which allows the team to import at the end of the competition and then elevate in seconds
Resources Link	https://www.youtube.com/watch?v=CIwaWguP58w&t=126

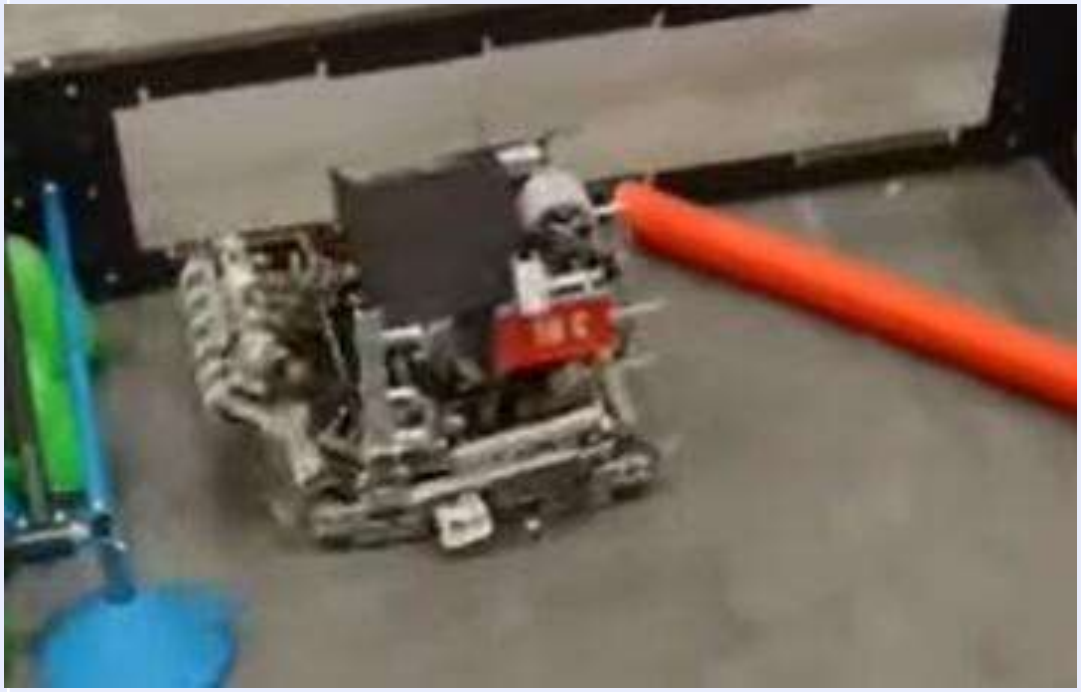
- >Part II:WORLD CHAMPIONSHIP:STRUCTURAL IDEAS DESIGN

Summary	1. The main attack methods of the robot are channel import and throwing triballs. It can open the wings of the corresponding side when either side is empty, and stably import multiple triballs. In games with high channel defense intensity, robot can adjust the competition and switch the position of defense robot by using catapult 2. Pneumatic C-tier elevation , which allows the team to import at the end of the competition and then elevate in seconds 3. After rapid using catapult and channel push strategy, the game may get stuck in a situation where there are no extra triballs. At this point, the wings can handle the triballs that is being defended into the triangle area, increasing the chances of scoring
Photo	

- >Part II:WORLD CHAMPIONSHIP:STRUCTURAL IDEAS DESIGN

Team No.	10C
Skills Rank	#271
Design Feature	1. The robot has the ability to cross barrier, and it was equipped with a shovel at the back end, which can increase the robot's adversarial ability and defend against the opponent's channel entry ability 2. A suspended wing and an inclined ground wing. Hanging wings can cross the barrier quickly and efficiently clean triballs in front of the barrier; Ground attached wings can make the channel entry of the robot more stable. But compared to the double wings, the machine's ability to clean triballs in front of the goal has decreased 3. Roller throwing device, and the upper limit of throwing speed and efficiency depends on the efficiency of the Importer in the team
Resources Link	https://www.youtube.com/watch?v=iKq5Srjxuk4

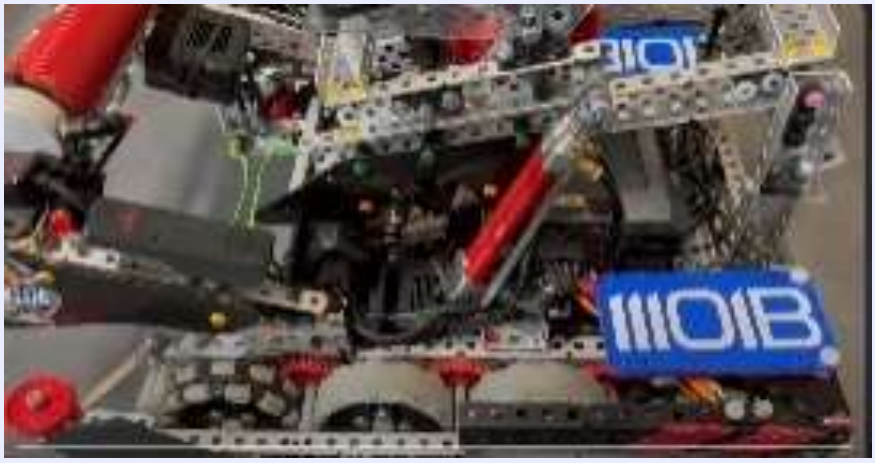
- >Part II:WORLD CHAMPIONSHIP:STRUCTURAL IDEAS DESIGN

Summary	1. The main attack method of the 10C is import attack. Because 10C have only one side wing, the robot will use more unilateral channel imports 2. Roller throwing device, which can quickly throw triballs but may not be used too many times, because Roller device throwing requires higher ability of the Importer to place the triball in the designated position and the speed of releasing the triball. Otherwise, the landing point of the ball will be extremely unstable. But this kind of unpredictable point can also surprise the team player in certain situations 3. The robot has the ability to cross the barrier and a shovel, which can enhance the machine's ability to defend against the opponent's robots' imports
Photo	

- >Part II:WORLD CHAMPIONSHIP:STRUCTURAL IDEAS DESIGN

Team No.	11101B
Skills Rank	#15
Design Feature	1. Pneumatic C-tier elevation , which allows the team to import at the end of the competition and then elevate in seconds 2. Fast and efficient triballs throwing device, which can emphasize the position of the defending team and increase scoring opportunities by throwing triballs when the defense intensity in the competition is high 3. The robot has the ability to cross barrier, and it was equipped with a shovel at the back end, which can increase the robot's adversarial ability and defend against the opponent's channel entry ability 4.Two same size wings, and do not have the ability to cross the barrier. However, in terms of import, the robot can be more flexible in channel import. The last two wings can hook out the triballs in the triangle area, increasing scoring opportunities
Resources Link	https://www.youtube.com/watch?v=lLKPLtkIjRU

- >Part II:WORLD CHAMPIONSHIP:STRUCTURAL IDEAS DESIGN

Summary	1. The robot can import though any channels, with more selectivity in attack. When one channel is defended, it can go to another empty channel to import multiple triballs 2. When the robot is blocked by the opponent in both channels, it can use catapult to break the deadlock and adjust the defender's position to drive the attacking 3. The robot has the ability to cross the barrier and a shovel, which can enhance the machine's ability to defend against the opponent's robots’ imports
Photo	

- >Part II:WORLD CHAMPIONSHIP:STRUCTURAL IDEAS DESIGN
- >>CHINESE TEAM

Team No.	666X
Design Feature	1. Two large wings in front of the robot that can quickly clean the triballs in front of the goal 2. The shovel on the back end of the robot can be lifted and can double cross the barrier 3. The intake is wide and can carry multiple triballs through the channel without the need for wings 4. The clutch is used for both high elevation and catapult, and a rubber band is used to pull the high elevation arm, with only B -tier elevation. The ratio of the throwing structure's gear is 1:4, and the speed is not fast. After lifting the high elevation arm to a certain extent, the side elevation arm will be opened and can be elevated in seconds.
Summary	High attack efficiency, capable of pushing channels' triballs, throwing triballs, and can quickly catching up with teammates throwing triballs in front of the goal. Moreover, a larger grip can increase fault tolerance and better protect the triball. On the defensive end, It can cross the barrier and then use it shovel to defend the passage.

- >Part II:WORLD CHAMPIONSHIP:STRUCTURAL IDEAS DESIGN

Team No.	9416U
Design Feature	1. A rope and rubber bands can be used for high elevation, allowing for quick C-tier elevate. The high elevation arm can also be used for side elevation, and the side elevation level can reach C-tier. 2. Two wings are fixed with thick shafts, and one wing can cross the barrier, and the other wing cannot. Double wings can quickly clean triballs in front of the goal. The ratio of the throwing device's gear is 1:3, and the speed is the same as ours.
Summary	Allows import though channel, or throw triballs to open up the situation and increase attack efficiency. High elevation speed is fast, and both high and side elevation can reach C-tier. The defensive end robot has a fast movement speed and can use a shovel to place channels for import

- >Part II:WORLD CHAMPIONSHIP:STRUCTURAL IDEAS DESIGN

Team No.	81988E
Design Feature	1. Pneumatic high elevation, capable of ultra fast C-tier elevation 2. Four wings, and the front two channel shovels are both inclined and cannot pass the club. When pushing the ball through the channel, it is possible to activate a single wing push. The last two wings are large wings, and when opened, they cover the entire front frame, allowing for quick cleaning of the ball in front of the frame. At the same time, both wings can hook out the ball in the triangular area. 3. The throwing speed is fast, and it can accurately and quickly cast in front of the frame.
Summary	1. Can both defend and attack, quickly clean up the triballs thrown by teammates in front of the goal, or switch to channels strategy with teammates to push multiple triballs on the left. At the same time, it can also throw triballs to create opportunities for 81988E’s teammates. 2. When all the triballs were imported , it can use the back wing to hook out the triballs in the triangle area, increasing chances of scoring

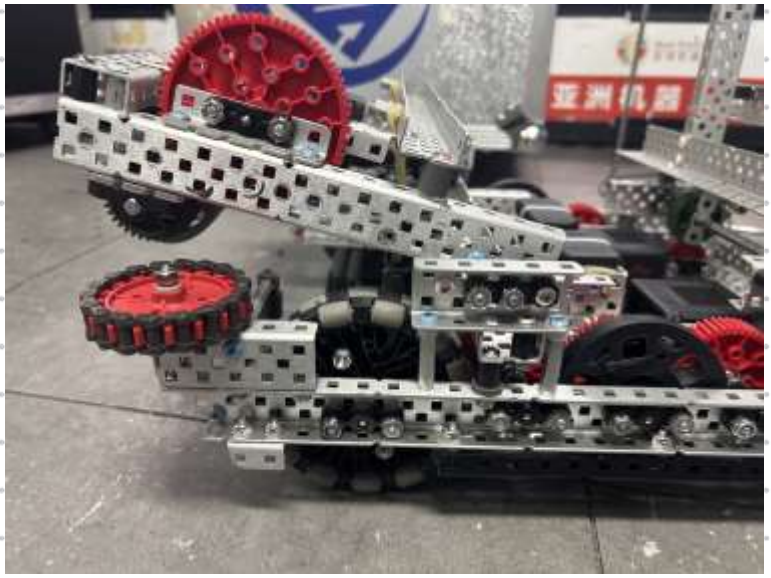
- >Part II:WORLD CHAMPIONSHIP:STRUCTURAL IDEAS DESIGN

Team No.	7258A
Design Feature	1. The robot is wide and do not have a high elevation structure. It has a side elevation structure which can reach A-tier and has two small wings that cannot cross the barrier and length of both wings is very short. 2.The ratio of the robot's catapult’s gears is 1:3, and the catapult’s speed is fast.
Summary	Can throw triballs to create opportunities for teammates, and can also import from channels, but the robot does not have high elevation. Side elevation cannot elevate in seconds
Team No.	9698B
Design Feature	1. Four wings, and the first two are inclined surfaces that cannot cross the barrier. The back wings can hook out the triballs in the triangle area 2. The robot can elevate to C-tier at a very fast speed and can also elevate at the side of the channel to A-tier. And both two method of elevation are released simultaneously. 3. Use an 11W red large motor with a catapult at a speed of 40rpm.
Summary	1. Can both defend and attack, quickly clean up the triballs thrown by teammates in front of the goal, or switch to channels strategy with teammates to push multiple triballs on the left. At the same time, it can also throw triballs to create opportunities for 9698B’s teammates. 2. When all the triballs were imported , it can use the back wing to hook out the triballs in the triangle area, increasing chances of scoring

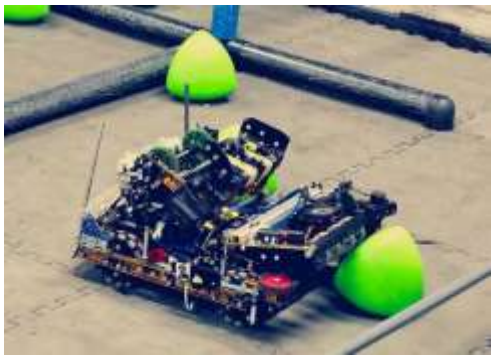
Part III

ASIA OPEN ROBOT UPDATES & WORLD CHAMPIONSHIP ROBOT DESIGN

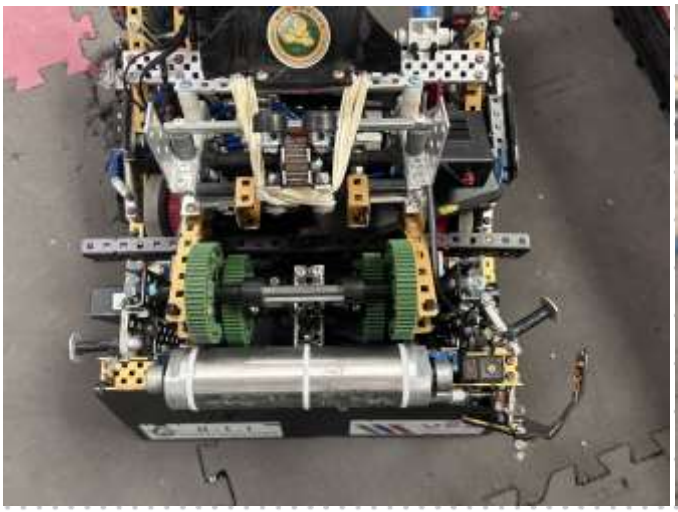
- **>ASIA OPEN ROBOT UPDATES**
- **05/03/2024**
- *Today we mainly modified the intake part of the robot. We still adopted the original structure of the intake as a whole, using rubber wheels instead of rollers to absorb triballs and adding a C-channel to strengthen lateral support. But during the Beijing Asia Open, we found that when the robot backwards, if robot held the triball, it was very easy to roll out. So in order to make the robot can catch the triball firmly, we tried to change the gear ratio of intake structure from 60t with 36t to 72 with 36t. In this way, the speed of the intake will become faster. Although the robot will spit out the ball with little force and the triball will still fall out of the intake's port when passing through the barrier, this is a common problem with small motor intakes, so we can accept these issues. After testing, it has been found that the robot can effectively take the ball when moving forward quickly and when emergency stopping and retreating.*



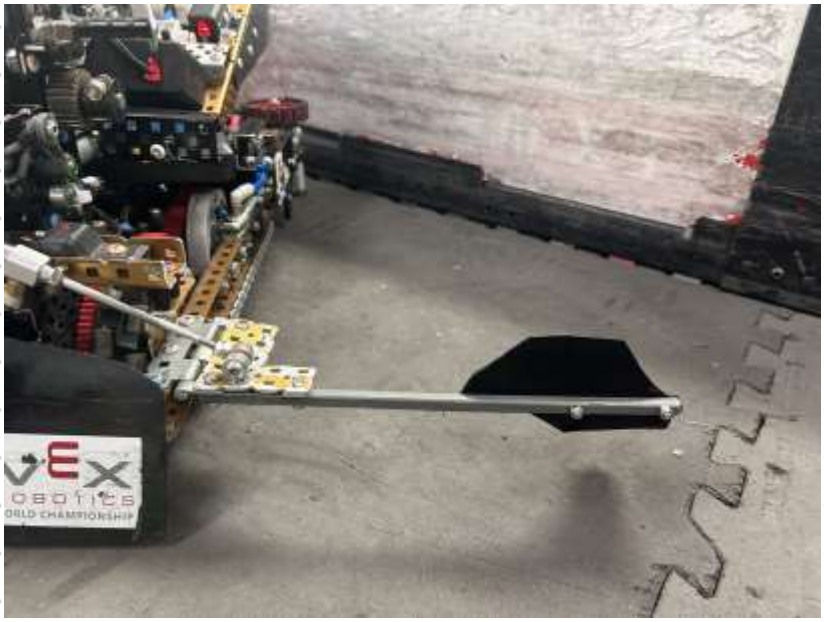
- >ASIA OPEN ROBOT UPDATES
- **06/03/2024**
- *Today we improved the function of the robot's high elevation and Rubber-bands-cutting structure. During the Beijing Asia Open, our high elevation and Rubber-bands-cutting structure were lifted by a robot and then hooked off with additional rubber bands to increase the pulling force on the high elevation arm. However, this version of the Rubber-bands-cutting structure has little effect on improving the high elevation speed. Firstly, because we do not have many additional rubber bands, most of them are directly tied to the high elevation arm. Secondly, because the cutting rubber band device can only be installed on one side(if both sides are installed, the motor will collide with the cutting rubber band device when the high elevation arm is lifted) ,causing the high elevation arm to be unable to lift up. So in this version of the Rubber-bands-cutting structure, we first changed the binding method of the robot's rubber band and the type of rubber band. When the high elevation arm is raised to a certain extent, the locking buckle will open, and the force arm will increase, so the tension of the rubber band will become greater.*



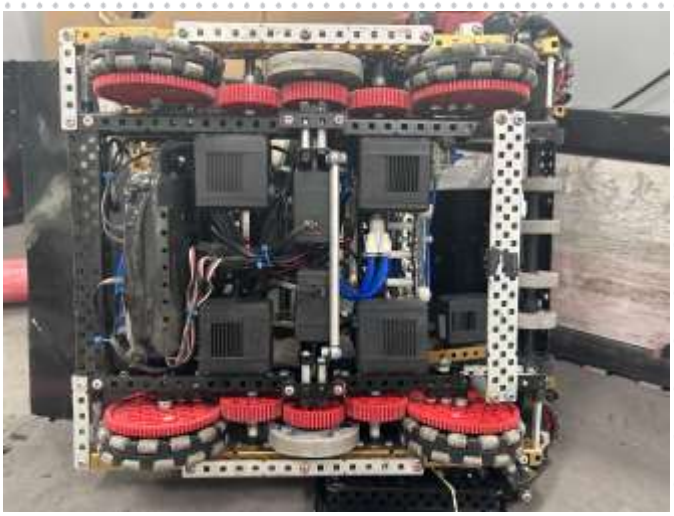
- >ASIA OPEN ROBOT UPDATES
- **06/03/2024**
- *Compared to the previous version, this set of rubber band cutting device can significantly increase the elevation speed of the robotic arm, and at the same time, both sides can be subjected to more uniform force. Afterwards, we have two ideas for raising the elevation arm: one is to use the motor to lift it in the original way, but due to the using of small motor, we still need to use gear reduction to raise the hanging arm. But in this case, the speed of high elevation will be limited. The second method is to use a pneumatic device to pull. First, use a cylinder to lift the high hanging arm to the critical point, and then use a second cylinder to lift it past the critical point and release the latch. In this way, the high elevation speed will be very fast, but the force required for the cylinder to lift over the critical point is still considerable. We will choose the most suitable option between these two options in the future.*



- >ASIA OPEN ROBOT UPDATES
- **07/03/2024**
- *Today, we made the back wings behind the robot, using a thick shaft and PC version, and used cylinder contraction to control the release and retraction of the rear wings. The main function of this rear wing is to hook triballs in the triangle-area. Therefore, we made the PC board into a hook shape, but after testing, we found that when there are multiple triballs in the triangle area, the balls can easily roll out of the rear wings. So we plan to use a PC board to stack the rear wings high. In this way, if we encounter teammates or opponents who use crazy triballs throwing to accelerate the pace of the competition's attack during the game, we can use our back wings to hook triballs out of the triangle area and continue to hold the triball for attack.*

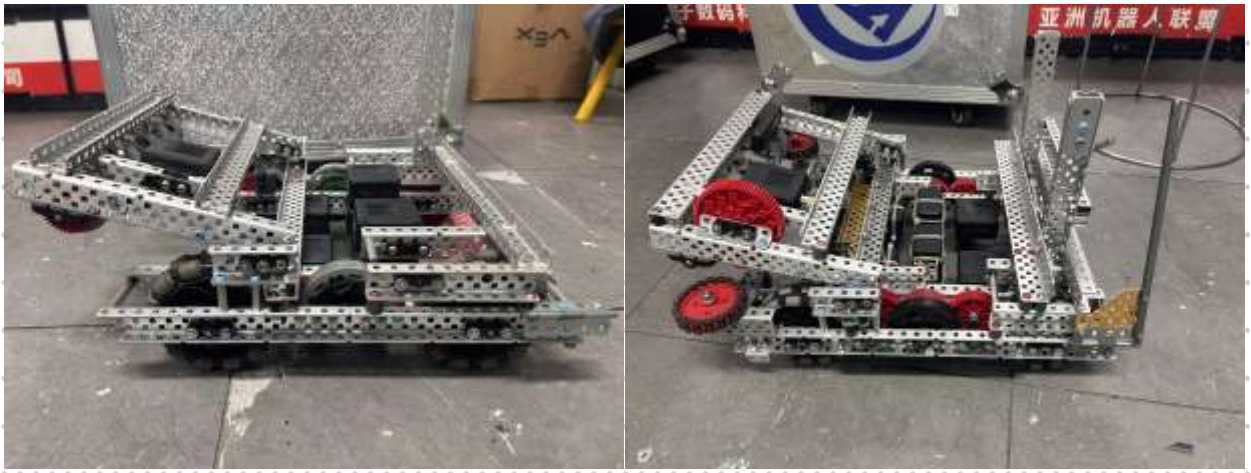


- **>ASIA OPEN ROBOT UPDATES**
- **08/03/2024**
- *We have two ideas for the chassis of our robot. The first option is to use the original 342 rpm chassis. The advantage of this chassis is that the robot's movement speed is fast enough to quickly push triballs in the channel or quickly retreat to prevent opponents from pushing triballs in the channel during the competition. But we found that the robot cannot run 342 speed at the current weight of the vehicle, and the motor of the robot is particularly prone to overheating. Therefore, we have a second idea, which is to use a 300 rpm chassis, while maintaining speed, to reduce the speed of motor overheating. At the same time, we want to move the two motors in the middle of the robot outward to make it more convenient to switch motors, as we cannot avoid some unexpected situations.*

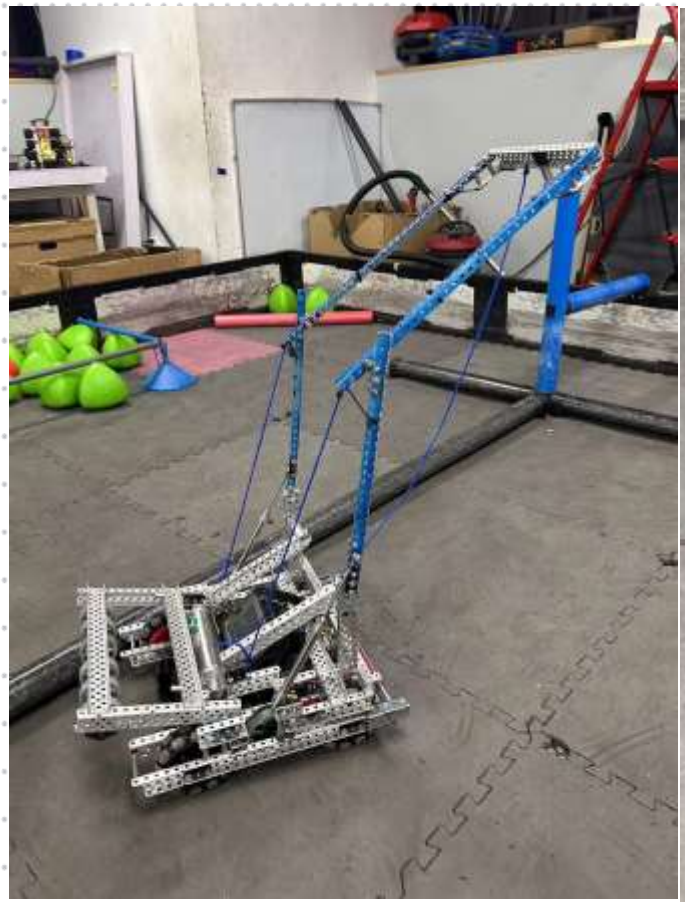


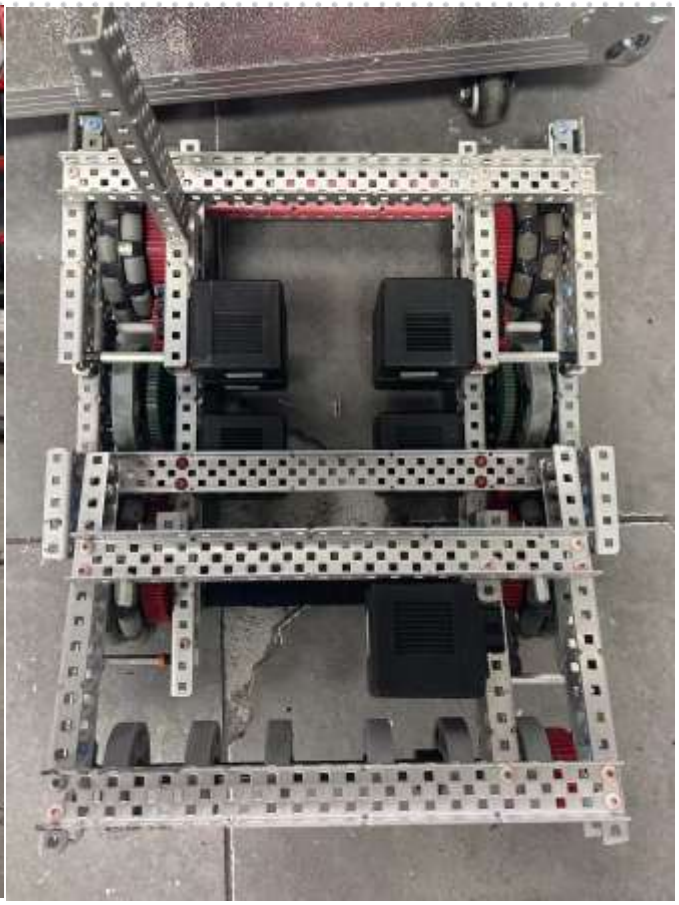
- >ASIA OPEN ROBOT UPDATES
- **13/03/2024**
- *Today, we made a new set of intake ports. Based on our plan, we changed the motor of the triball port from a small motor to a red motor, enhancing the machine's ability to intake and grab the triball. At the same time, we made an intake similar to the original robot, using rubber wheels to intake and spit out triball, which can make the triball staying in the intake port firmly. Then, we added a horizontal support C-Channel at the end of the intake to prevent excessive shaking of the intake from affecting. In addition, we have made the high elevation bracket even higher, so that its height is just enough to pass through the side channel. Because we have found that if the bracket of the high elevation arm is maximized, the initial position of the arm can be raised higher, and the upper force arm is smaller, making elevation faster and easier.*

- >WORLD CHAMPIONSHIP ROBOT DESIGN
- **09/03/2024**
- *For the World Championship robot, we want to make a robot that can hang though horizontal and vertical elevation bar. because in the latest rules, the yellow cover on the vertical elevation bar's top has been removed, which gives us the opportunity to elevate to achieve G-tier. On the chassis, we still want to make the original 6-motor chassis. We'd like to use a speed of 300 rpm first because we are afraid that the robot will be too heavy in the future. However, if the robot is about 7.5kg after completion, we will use the original 342 rpm design. In terms of intake, we plan to use a large motor to drive the intake structure, because after using a small motor for two consecutive matches, we found that using a small motor to drive the intake does not have the snatch and suction functions. During matches, the robot often behaves situations where the triball was dropped during the robot was moving back, which has a significant impact on the game results.*

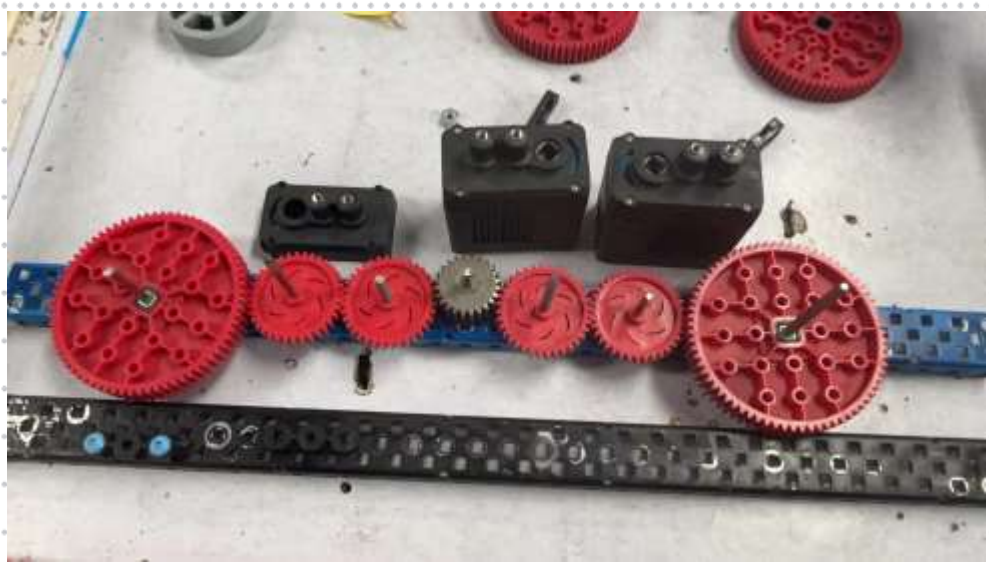


- >WORLD CHAMPIONSHIP ROBOT DESIGN
- **09/03/2024**
- *We are still planning to use rubber wheels to make intakes, because after multiple matches of quality inspection, the ability to absorb and grab triballs will be better than the roller. In terms of catapult design, we plan to refer to the catapult's ratio of 9698B and use a gear ratio of 24:60. This way, the catapult speed is 40 revolutions per minute. Compared to our original speed of 50 revolutions per minute, the 40 revolutions per minute full speed will be faster when the force is similar, allowing for better performance in the competition.*

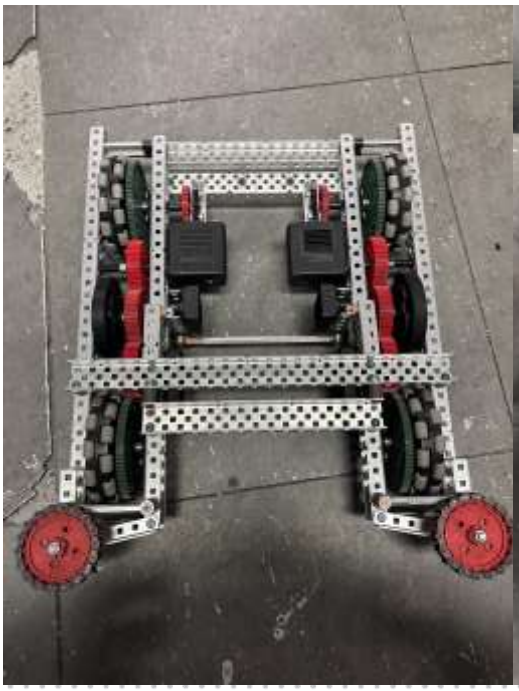




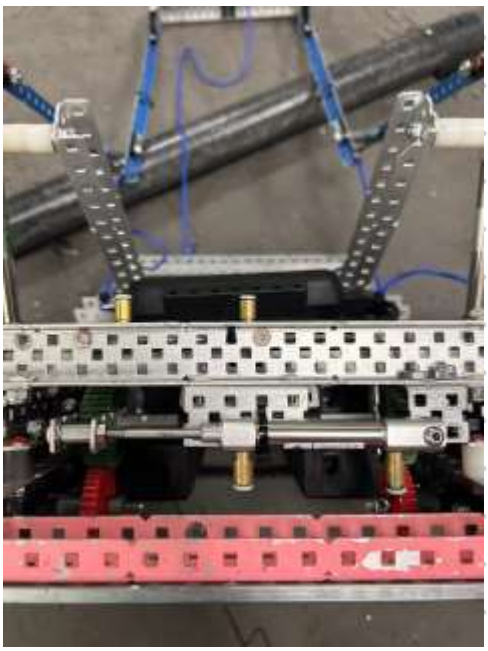
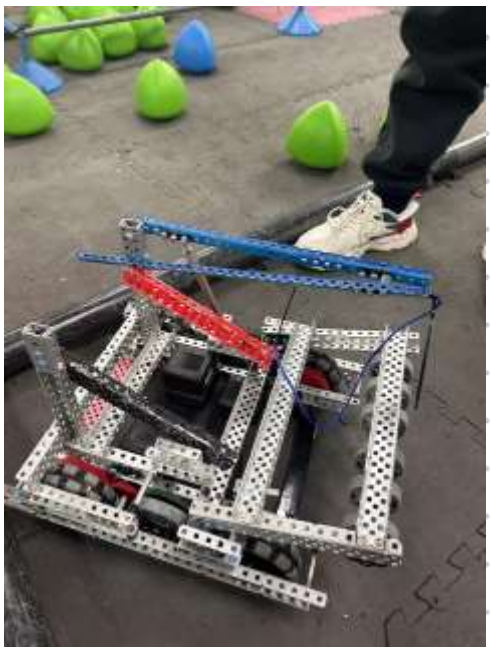
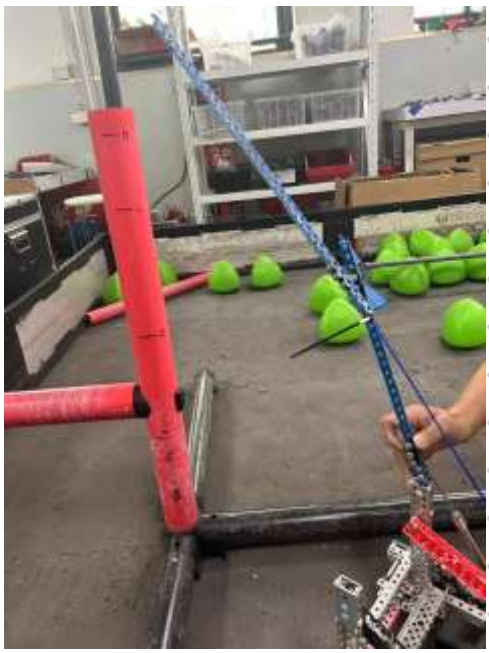
- >WORLD CHAMPIONSHIP ROBOT DESIGN
- **12/03/2024**
- *Today we started designing the robot for the World Championship. In terms of chassis, we first adjusted the rotational speed of the chassis from the original 342 to 300 rpm. Because we are afraid that we will make the robot too heavy in the future, which will cause the robot not able to run at 342 full speed and will also accelerate the heating speed of the chassis's motors. At the same time, a 300 RPM chassis can enhance resistance and delay motor heating while maintaining a certain speed. In terms of wheel selection, we still used the old large wheels because compared to the new wheels, the large wheels have a larger touchdown area, which can reduce the pressure on the ground. On the layout of the motor, we horizontally install the motor that was originally installed vertically, and stack the two motors on one side.*



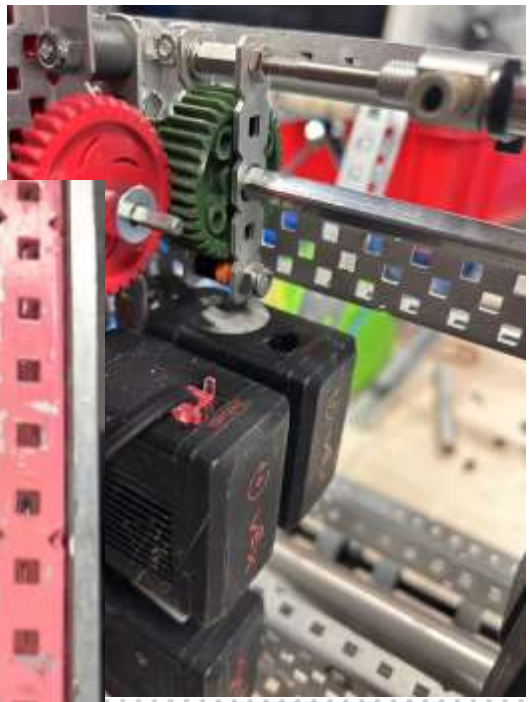
- >WORLD CHAMPIONSHIP ROBOT DESIGN
- **12/03/2024**
- *So that the center of gravity of the robot can be adjusted backward when the motor is placed, and it will be easier to elevate, because if the robot is regarded as a lever, the force arm will become smaller. At the same time, the last two motors are stacked together, and the front motor can be placed horizontally to switch motors more quickly and conveniently. In addition, we have also designed the double barrier-passage structure(after analyzing the game replay video, we found that this can achieve faster barrier crossing speed and can easily defense channels' triballs. As for the shovel, we have decided to make one that can be lifted and retracted, firstly because Skills requires shovels to tackle triballs, and secondly because shovels can enhance the robot's combat ability.*



- >WORLD CHAMPIONSHIP ROBOT DESIGN
- **14/03/2024**
- *Today we made the folding side elevation arm and clutch parts of the robot. We hope that the folding side elevation arm can be quickly elevated up and reach at least E-tier elevation, so we used a section of 28 hole 1*1 C-channel and a section of 33 hole 1*1 C-channel for the use of folding robotic arm. In terms of opening the elevation arm, we choose to use a cylinder to lift the first section of the robotic arm. The second section of the side elevation arm will be pulled up by a rope when the first section is raised. At the same time, to prevent the second section of the side elevation wall from falling off after it is raised, we have tied rubber bands on both sides to pull it up when it falls. We want to use a rope to retract the side elevation arm after elevation the vertical elevation bar on it. Therefore, we equipped a clutch device on the robot's chassis.*

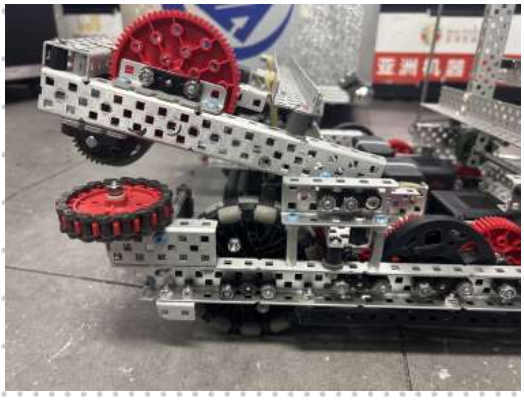




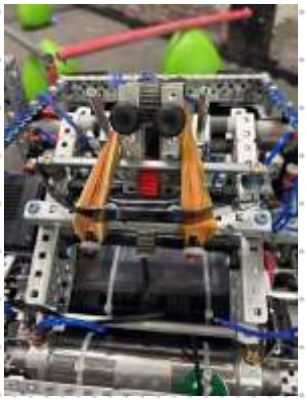
- **>WORLD CHAMPIONSHIP ROBOT DESIGN**
- **14/03/2024**
- *We replaced the short and thin shafts of the rear two wheels with long and thin shafts, and equipped a gear on each extension part. Then we use a cylinder to control the extension and retraction of the gear on the coarse shaft. When the cylinder is turned on, the gear on the coarse shaft will be connected to the gear on the extended part of the wheel. Therefore, when the wheel rotates rapidly, the coarse shaft will rotate quickly, and the rope connecting the second section of the side elevation arm will also be quickly tied together with the rotation of the coarse shaft, so the robot will rise.*



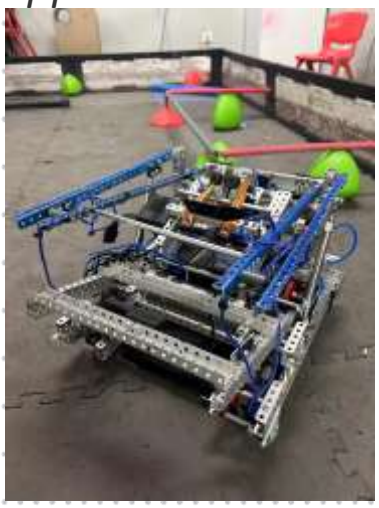
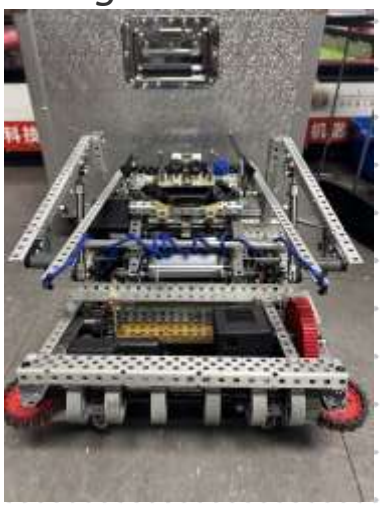
- >WORLD CHAMPIONSHIP ROBOT DESIGN
- **16/03/2024**
- *We have changed the original 300 RPM speed chassis back to 342 RPM chassis. Although a 300 RPM chassis can enhance the robot's starting speed, resistance, and can slow down the motor's heating speed, also can make the center of gravity of the robot as a whole move backwards. When elevate, the force arm will be shorter, and the robot can move faster and more easily when elevating. However, the 342 RPM chassis has a faster speed compared to the 300 RPM chassis, the robot will be more agile. It has a slight advantage over the 300 RPM chassis in pursuit and defense, as well as channel entry. Because the 342 RPM chassis is faster than the 300 RPM chassis, the automatic part can quickly grab triballs in the middle of the field, and the Driver part can also rely on this slight speed advantage to quickly import multiple triballs though channel. For the operator, they will be more familiar with the 342 RPM chassis. In addition, we also installed double wings at the back of the robot and made a hook , which can hook out triballs in the triangle non-score area.*

- **>WORLD CHAMPIONSHIP ROBOT DESIGN**
- **17/03/2024**
- *We still adopt the small motor to take the ball, because the small motor cannot pull the ribbon in the catapult device, we decided to install the large motor on the catapult device. In the gear ratio, the original 36t→60t is changed into 36t→72t. In this way, the speed of Intake will be faster, the adsorption of the triball will be better when the robot retreats and swings, the triball will not be thrown out from the triball's room easily and the probability of the robot being snatched by the triball will be reduced. Although the ball-picking force of the machine is very small and the triball will fall out of the intake hole when passing through the barrier, this is a common problem of small motor ball-picking, so we can accept this problem. In addition, we also follow the ball intaking mode of the medium sleeve rubber wheel of the coarse shaft in Beijing Asia Open. Although the rubber wheel is easy to deposit dust, it will reduce the friction between the rubber wheel and the triball, which needs to be wiped frequently, but this mode can smoothly suck the triball and is durable in most cases.*





- **>WORLD CHAMPIONSHIP ROBOT DESIGN**
- **18/03/2024**
- *Today, we installed the support structure of the high elevation arm on the machine, and designed the height of the high elevation bracket to just pass through the barrier. Because if the height of the high elevation bracket is not high enough, the side elevation arm cannot reach the elevation bar's top even the cylinder is pulled to the bottom, so we set the height of the high elevation bracket to just pass through the horizontal elevation bar of the channel, reduce the stroke of the cylinder, and make it just pull to the best position. At the same time, the robotic arm can also slightly move the center of gravity of the machine backward when it is just passing through the channel, so that the robot's force arm will be bigger when it is side elevating, and it is easier to pull the robot up. In addition, a more rearward center of gravity also increases the grip of the machine, making the robot more resistant and allowing push our opponents into the triangle area and import.*

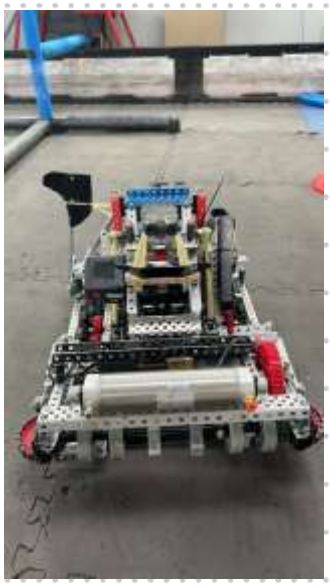



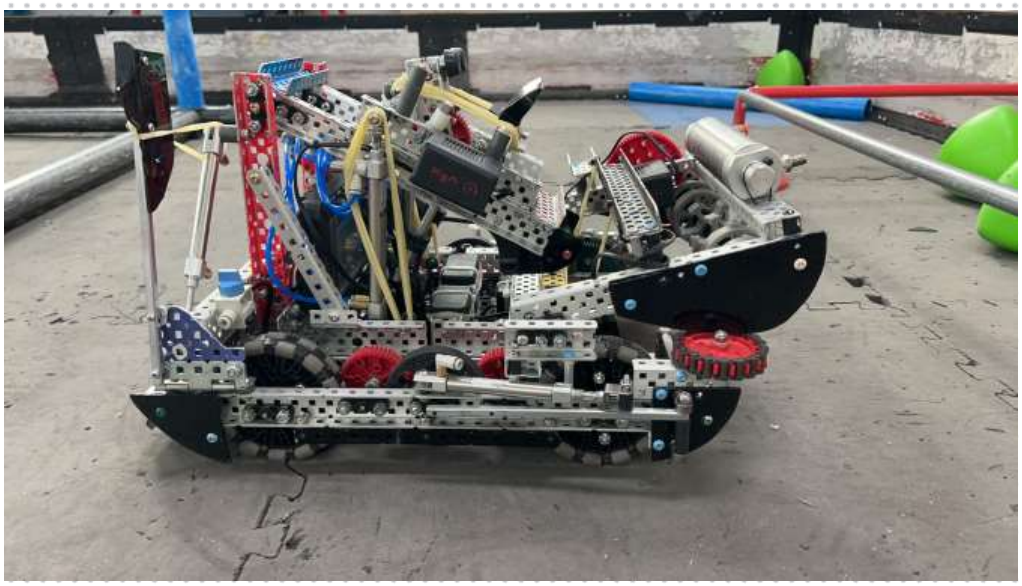

- **>WORLD CHAMPIONSHIP ROBOT DESIGN**
- **25/03/2024**
- *Over the weekend, we conducted a vertical elevation bar elevate test on a robot with a 342 RPM chassis. However, during the testing process, we found that the 342 RPM chassis robot cannot elevate though vertical elevation bar, and even experienced gear scrapping situation. After inspection, we found that it was because the gears of the robot's clutch device were not engaged, and the bearing bracket of the coarse-shaft used was also enlarged with an electric drill through the hole position. However, after solving the hole position problem, the robot still encountered the problem. So we plan to implement a gear ratio reduction measure of 1:2 on the clutch structure. but after internal discussion, we believe that if the robot does a 1:2 reduction on the clutch device, the speed of elevation on the side will be very slow. We accessed to Youtube, found that most people use a 600 RPM speed elevation structure on the side of their machines, even an 800 RPM structure. Our machine elevates at a speed of 300 rpm, but it can't go up at 342 rpm, which indicates that there is a problem with the structure of our robot. After discussion, we have ruled out issues related to motor performance and clutch structure, and believe that the problem is the geometric angle between the robot's side elevation structures has not been adjusted properly.*

- >WORLD CHAMPIONSHIP ROBOT DESIGN
- **25/03/2024**
- *Later, we also discussed with some members of other teams and felt that adjusting the geometric angle at this stage would take a long time and a long work cycle, and we no longer have enough time to readjust this geometric angle. In addition, we believe that side elevation are not practical at the tactical level, because after watching many competitions, we have found that the strategy for most games will be to throw triballs crazily, quickly import in the channel, and finally elevation. Therefore, vertical elevation is not in line with our strategy of back and forth attack and defense, and is not conducive to our operation. Moreover, the weight of the side elevation machine reaches 8 kilograms, which is really too heavy. At this weight, the 342 RPM chassis actually cannot reach its full speed, so this robot will have disadvantages in both Autonomous and Driver period. If we change to a 300 rpm motor, firstly, the machine will have disadvantages in the Autonomous part, and secondly, the 300 rpm chassis needs to be stacked with the motor, which will require an additional shaft to make a set of transmissions, resulting in greater friction. So in the end, we decided to do a quick pneumatic C-tier high elevation to adapt to the current strategic trend of the competition.*

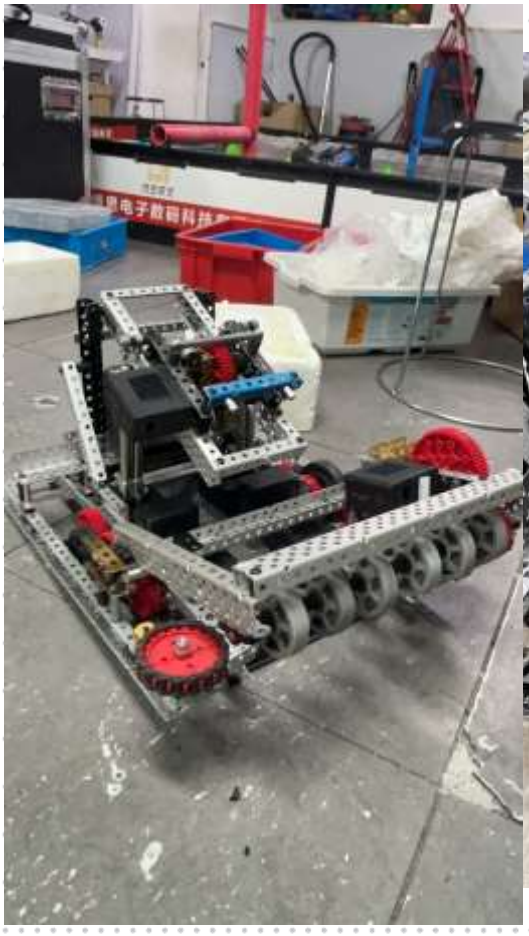
- **>WORLD CHAMPIONSHIP ROBOT DESIGN**
- **26/03/2024**
- *Today we mainly built the chassis of the robot and the two wings at the front end of the robot. In terms of chassis selection, we still used a 342 RPM chassis. As for the reason why we don't use a 300 rpm chassis, one reason is that compared to robot with high elevation ability on vertical elevation bar, our pneumatic C-tier elevation robot is much lighter. It can run the 342 RPM chassis to its full capacity, and the speed is faster than that of a 300 rpm motor. It has more advantages in the Autonomous for grabbing triballs and the Drivers period for fast import of multiple triballs through the channel. The second reason is that a 300 RPM chassis requires the motor to be stacked, which makes the process more complex, and we also need to add a set of transmission gears, resulting in greater friction. Moreover, after the motors are stacked, the overall center of gravity of the machine will be further back, making it easier for the robot to overturn when passing through barriers; And our machine hopes to have double barrier crossing structures on both sides of the chassis. In terms of the chassis motor design, we still follow our original idea to make a motor that is easy to disassemble and install, because this type of motor structure can replace the gearbox faster without any motor damage.*

- **>WORLD CHAMPIONSHIP ROBOT DESIGN**
- **26/03/2024**
- *Therefore, we need to spend a lot of time and dismantle many machine components to replace the motor. The only downside is that in intense competitions, the robot may experience motor drops situation, but we basically avoided this problem by tying multiple rubber bands and straps. In addition, we have modified the original shovel structure of the robot by replacing the original integrated PC with a double-layer foldable PC board, which allows the machine to retain the defensive strategy and strength of the original shove triballs while also performing double barrier crossing. In terms of wings, we will continue to use the original double wings, using a tilted large PC board to push triballs on one side and a thick shaft and PC board that can cross the barrier on the other side. This can ensure both the flexibility of channel entry in regular matches and the ability of machines to clean corner's triballs in Skills.*

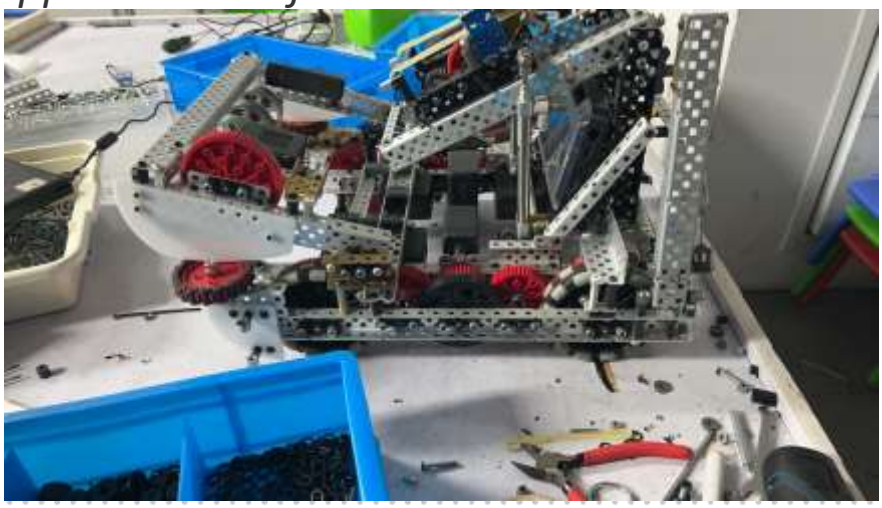




- **>WORLD CHAMPIONSHIP ROBOT DESIGN**
- **27/03/2024**
- *Today we mainly focused on the Intake part and the Rear wing part of the machine. In terms of Intake design, we chose a large motor to handle the suction and discharge of the triball. Because in the previous 4 games, we used small motors to drive the Intake part, which resulted in the first few robots showing very poor suction and discharge functions during the game. And because we decided to use cylinders for pneumatic high elevation, it saved the robot's space to use large motors to drive intakes.*

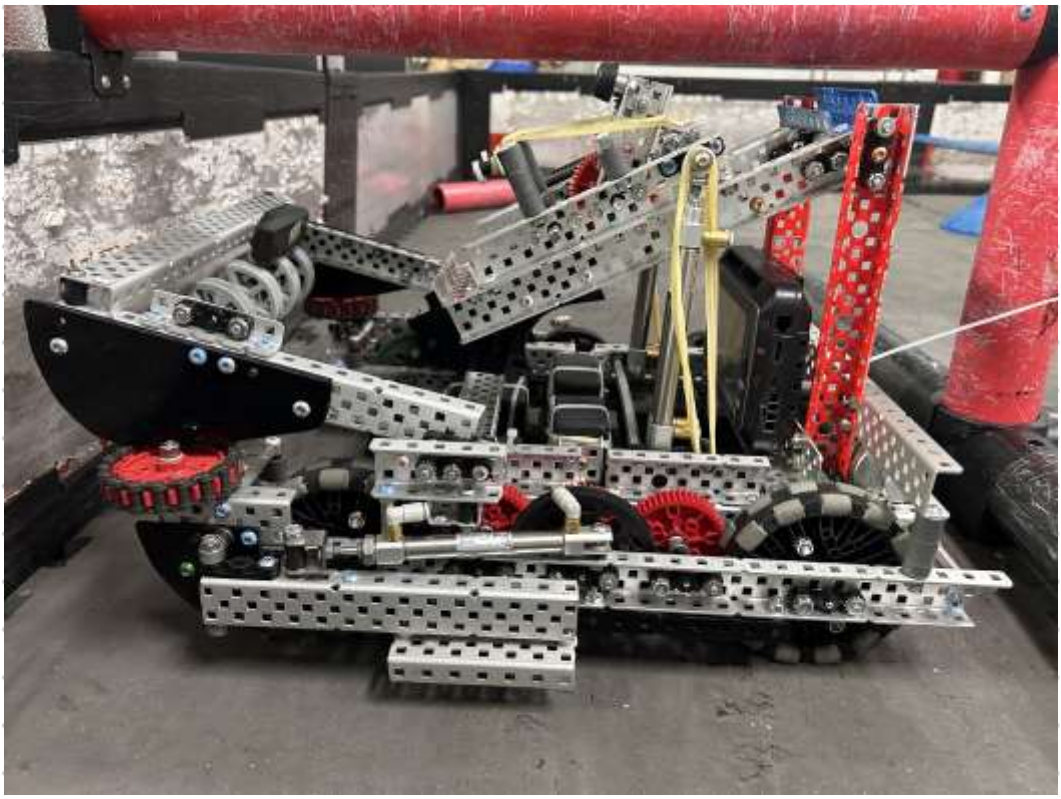


- **>WORLD CHAMPIONSHIP ROBOT DESIGN**
- **27/03/2024**
- *In the gear ratio, we have changed from the originally envisioned 36:60 to 36:72 gear ratio. In this way, the intake's triball suction speed will increase, and the machine's ability to absorb the triball will be better when it moves backwards and swings, making it less likely to be thrown out of the ball room. At the same time, it can also reduce the probability of the robot's ball being snatched. In terms of the rear wings of the robot, we have adopted the original design structure, with a thick shaft as the main body and a PC as the hook that can hook the triball away from the triangle area. By using two cylinders to control the release and retraction of the rear wings, the machine can perform hook and score movements in various triangle areas. Meanwhile, in a tactical sense, the back wings allow us to use them to hook triballs that have been defended in the triangle area after fast throwing and Channel-Push strategy, increasing the scoring opportunities of the robot.*

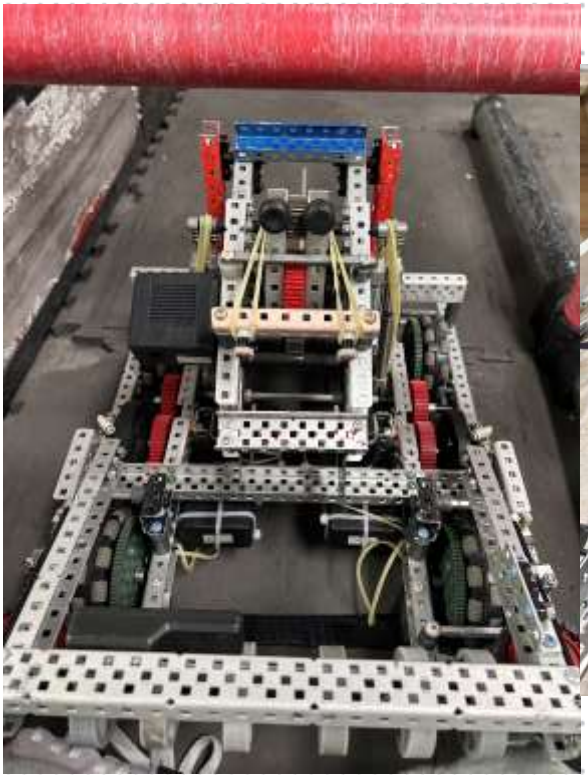


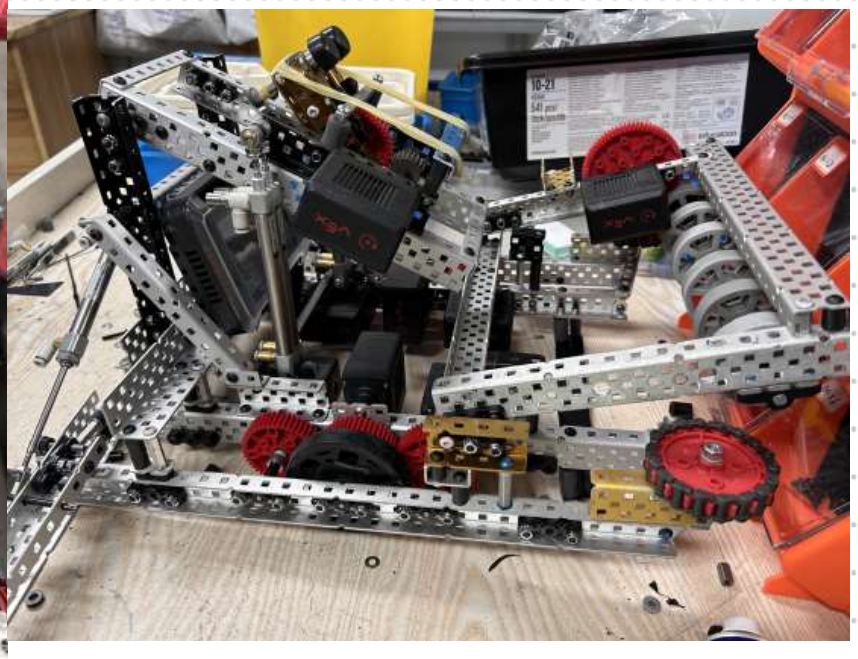
- >WORLD CHAMPIONSHIP ROBOT DESIGN
- **28/03/2024**
- *Today we mainly worked on the high elevation device of the robot. In previous versions, we used a small motor and a 1:25 ratio gear set, which made our high elevation very slow. Although we have implemented a switch structure later, which greatly accelerates the high elevation speed of the robot and can even complete high elevation within a few seconds, considering the poor suction effect of the small motor Intake, we plan to use four cylinders to make the high elevation power structure of the machine. In addition, we still made the robot's high elevation bracket the highest point that can pass through the channel, which allows the robot's cylinder to pull the machine with a shorter distance.*

- **>WORLD CHAMPIONSHIP ROBOT DESIGN**
- **28/03/2024**
- *This can accelerate the speed of the robot's elevation. In order to make the robot elevate more accurate and smoothly, we used a PC board to guide the high elevation arm of the machine, and also set a limit on the robotic arm of the machine with two wheels to fix the robot and ensure that the stable high elevation reaches C-tier. This approach can give the controller more opportunities to operate, push the ball, or perform the final wave of import in the game. But the machine may experience situations such as being heavy on the head and light on the feet, so we need to further adjust the high elevation limit of the robot.*

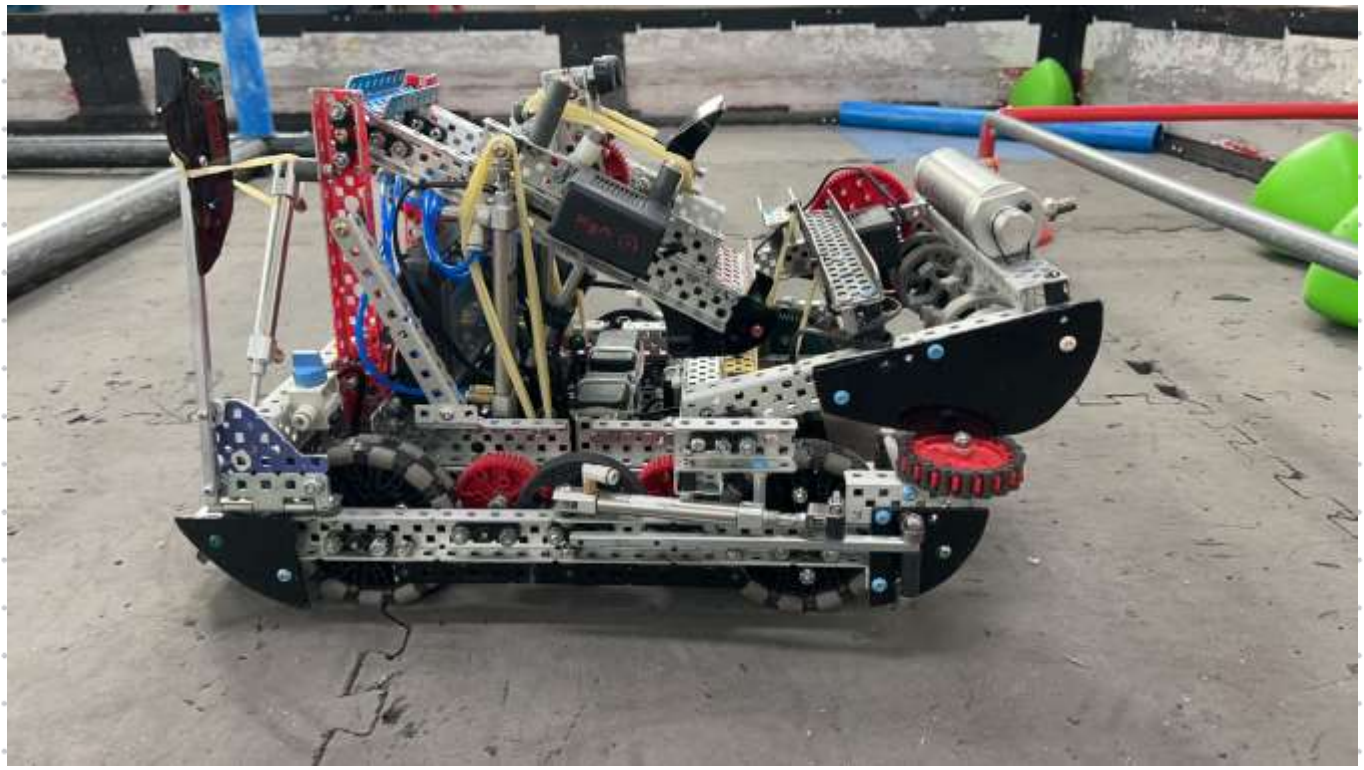


- >WORLD CHAMPIONSHIP ROBOT DESIGN
- **29/03/2024**
- *Today, we installed and adjusted the robot's catapult device. For the catapult position selection, we decided to mount it on the robot's high elevation arm. This decision was made to improve the robot's center of gravity. In the Xi'an National Championship, we had positioned the catapult structure at the rear of the robot, resulting in uneven weight distribution, causing the robot to tilt and only reach a B-tier elevation. This imbalance also overloaded the chassis, preventing the robot from achieving its full speed of 342 RPM, putting us at a disadvantage in both the Autonomous and Driver periods.*

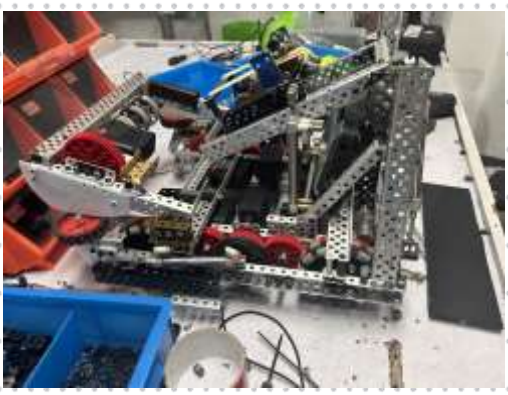




- **>WORLD CHAMPIONSHIP ROBOT DESIGN**
- **29/03/2024**
- *Placing the catapult at the front of the robot will make adjusting gears and adapting ratios much more convenient. To create more space for the tri-ball mechanism, we removed the gold-colored side supports from the previous version used in the Asia Open, reducing the robot's overall weight. Regarding the gear ratio design, we opted for a red 11W motor and maintained the original 1:4 ratio. Additionally, we adjusted the catapult's speed to 75 RPM. While this change may pose challenges for our team, it underscores the importance of further practice to master these adjustments.*



- >WORLD CHAMPIONSHIP ROBOT DESIGN
- **03/04/2024**
- *We made adjustments based on the robot, both in terms of the robot's weight and the allocation of motor on the chassis. We replaced all the imperial screws with metric ones, which significantly reduce the weight of the robot and allow it to run as fully as possible on the 342RPM chassis, reducing heating. In addition, we changed the allocation of motor space by moving the previously upright motors one slot outward on the C-channel. However, moving the motors outward means a decrease in the strength of the chassis channels, so we used a flat aluminum channel to fix the motors and enhance the strength of the gap where we cut. The space freed up on the chassis can be used to accommodate cylinders or batteries to adjust the robot's center of gravity. Because the previous machine had a tendency to tilt forward due to its center of gravity, this adjustment allows us to keep the center of gravity as close to the robot's center as possible. Additionally, a lower center of gravity reduces the risk of the machine being overturned directly in case of collision.*

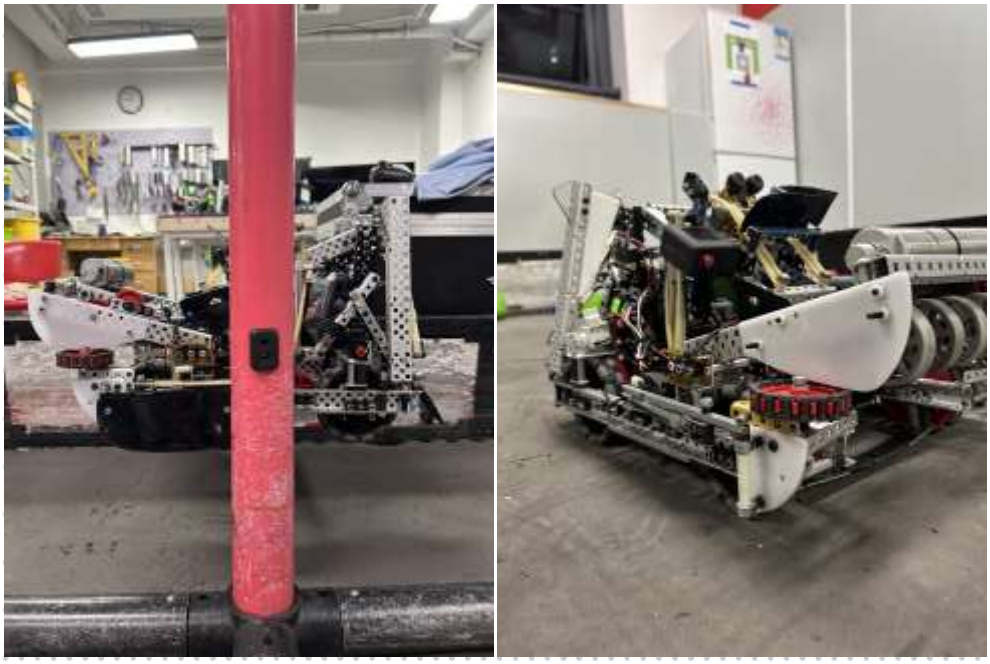


Part IV WORLD CHAMPIONSHIP UPDATES

- >WORLD CHAMPIONSHIP UPDATES
- **06/04/2024**
- *In Training matches, we discovered some issues with the current state of the robot and made temporary improvements to address them. Firstly, the robot was being knocked over directly when defending against the opponent during the match. This was because originally we intended to use a dual overpass to enhance the robot's speed in passing the barrier, enabling it to quickly position itself and disrupt the opponent's pathway. However, this led to the robot lacking any anti-fall device, resulting in direct overturning. To address this issue temporarily, we modified the originally foldable rear shovel into a large piece of PC board to prevent tipping. Additionally, to prevent the large PC board from collapsing outward when compressed, we added two thick shaft collar to the end of the large rear shovel PC, allowing the PC board to slide outwards when pressed. The second issue is also related to the rear overpass.*

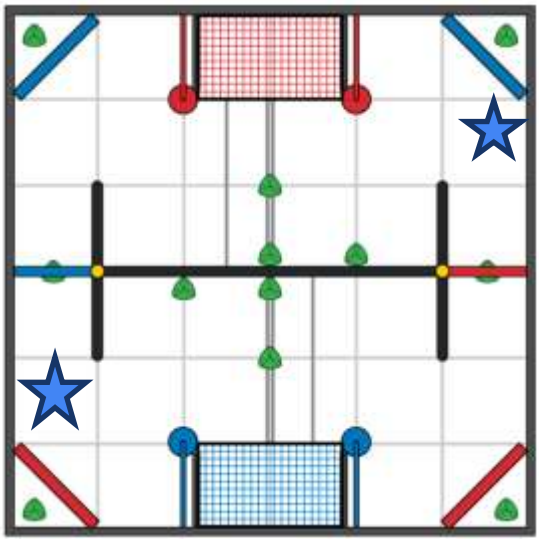
- >WORLD CHAMPIONSHIP UPDATES
- **06/04/2024**
- *The robot‘s rear overpass PC on both sides became stuck in the field’s walls during channel importing, significantly slowing down the robot‘s import speed and giving the opposing defenders ample time to defense. So we removed the PC from the rear overpass of the robot. The third issue concerns the robot's left wing. During the match, the robot's left wing couldn't fully unfold during channel import due to its excessive length, causing blockages during import and preventing passage through the channel when reversing for importing. Therefore, we immediately replaced the robot's left wing with a shorter spare wing. Additionally, there was a problem with the cylinder of the robot's left wing being knocked out of position. This requires the operator to pay attention to the defender's position when pushing the ball through the channel and retract the wing promptly when being defended. The fourth issue concerns the robot's elevation device. In the final moments of the match, we found that the robot's elevation level could only reach B-tier, mainly because the robot's center of gravity was still too far forward when suspended. To solve this problem, we forcefully pulled the position of the air tank on the robot's intake backward and replaced the PC board used to protect escaped triballs with team signs in the two rear wings of the robot.*

- >WORLD CHAMPIONSHIP UPDATES
- **06/04/2024**
- *We also adjusted the screws to their maximum length to try to adjust the robot's center of gravity as much as possible. Additionally, another problem arose when the robot's ball room contained a triball, causing the hanging device to fail to lift. This was because the robot's intake device would jam the elevate device when elevated, preventing the high-elevation mechanism from starting. Our temporary solution is twofold: first, the operator should check whether there is a triball in the room during the final elevation, and second, we installed a limit for the intake using a rope, restricting it to elevate only outside the range of the pneumatic elevation device's circular motion. These are the problems encountered during the training match. We will make more specific improvements next week.*



- **>WORLD CHAMPIONSHIP UPDATES**
- **10/04/2024**
- *In the new version of the World Championship rules, there are extremely high requirements for the loading specifications: two balls cannot cut into the ground plane at the same time, and there must be an obvious movement of releasing one by one. This limits the speed of loading and places higher requirements on the position of the ball. After discussion, we decided to have the loader place both hands on the side of the court to prepare, while the other loader reduced the amount of loading and strictly controlled the speed. Fortunately, our machine is equipped with a catapult platform, which is very close to the edge of the field, so that we will basically not violate the rules when catapulting.*
- *After two days of training matches, we found that we must slow down the import speed as much as possible to avoid fouling. Because according to the current rules, if there are illegal imports in three consecutive games or if more than six balls are illegally imported in a single game, a direct DQ will be issued. At the same time, if the illegal score affects the result of the game, a direct DQ will also be conducted, and the consequences will be very serious. We finally decided to keep the current pose unchanged and try to be familiar with the rhythm.*

- >WORLD CHAMPIONSHIP STRATEGIES
- 10/04/2024
- *Game strategy*
- *After more than half a season of games, we have also summarized the overall game style and general tactics.*
- *The opening is a very important part of the game. The current mainstream automatic programs can be summarized as follows:*
- *Autonomous*
- *For the backfield autonomous, that is, the machine close to the operator's side, the ball in the corner is usually hooked first, and then the two balls in the middle are pushed to the opposite side. There are also some radical playing styles that choose to directly grab the two balls in the middle to interfere with the opponent. Therefore, controlling the middle two balls is the key to winning the autonomous phase.*

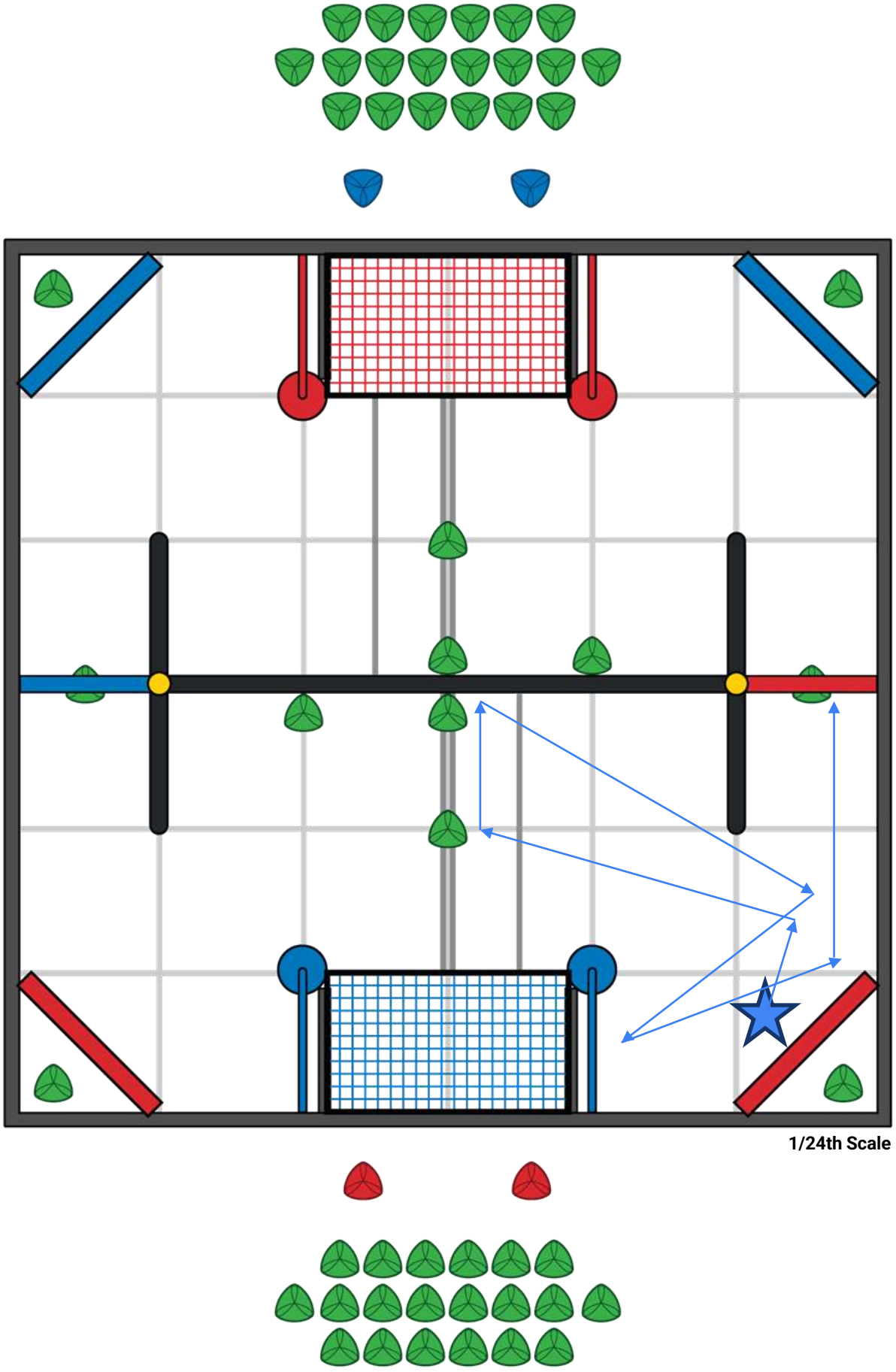


- **>WORLD CHAMPIONSHIP STRATEGIES**
- **10/04/2024**
- *For front-field autonomous, that is, machines that are far away from the operator, they can be summarized into three moves. The first is a steady move of directly placing the team's rice balls in the ball suction port and clearing the three middle balls one by one. This style of play has a lower score, but it is less likely to be interfered by the opponent and lead to overstepping the boundary. The second is to start the machine by sticking to the corners. It is a common move to hook the corner ball first and then clear the three middle ones. This type of move scores higher, but the ability to control the midfield ball is very weak and generally cannot be fully utilized. The last one is a radical six-ball move that starts with the channel, first absorbing the channel ball, then hooking the corner ball, and finally clearing the three balls in the middle. The score is very high, and as long as you step out, you are almost certain to win automatically, but the program is also unstable accordingly.*
- *So we can roughly determine the approximate positions of the four machines on the field after they finish automatically. The backcourt machines are usually near the lead-in area, and the frontcourt machines are usually on the right side of the net near the center pole.*

- **>WORLD CHAMPIONSHIP STRATEGIES**
- **10/04/2024**
- *Driving*
- *The first wave of games started in the first few seconds of the manual phase. For the backcourt machine, you can choose to directly use the pole to introduce and push three to four balls, but this will easily be directly intercepted by the opponent's frontcourt machine; you can also choose to import one to two balls without fear of being intercepted, but the opponent's frontcourt machine can go Assist teammates to launch the first wave of offensive; or use fake moves to pretend to import two goals, and then continue importing after the opponent's frontcourt machine is gone. In short, the behavior of the opponent's frontcourt machine will directly affect the rhythm of our attack. At this time, we should seek stability first and then look for opportunities. After this period of play, the position of the machine is no longer fixed, and positions are often changed, and the terms "front field and back field" are no longer used.*
- *After both sides launch one or two waves of offensive, the positions of the machines will be more random, but there are also some rules that can be summarized.*

- **>WORLD CHAMPIONSHIP STRATEGIES**
- **10/04/2024**
- *First, try not to pass from the middle unless there are a lot of loose balls on the court. Because when the opponent attacks, they are likely to seize the few seconds when you turn around and attack directly, making you unable to defend and reducing your efficiency. Second, because many machines currently have the ability to hook the ball from the corner, when defending, you must not only push the ball into the corner, but also transport it to the opposite side as much as possible. Third, when the enemy and we are entangled in the introduction area, we can push the enemy's machine behind ours and at the same time use the pole to directly introduce it. For catapults, it is best to seize the landing point of the opponent's ball to defend, and directly spread your wings to push the ball to the opposite side.*
- *In the last thirty seconds, you should be careful not to engage in behavior that may interfere with the high-flying game. Before you high-flying, you can import more low-scoring balls to increase the number of low-scoring balls.*
- *During the game, pay attention to the loading rhythm and try not to leave any balls left.*

Autonomous L1

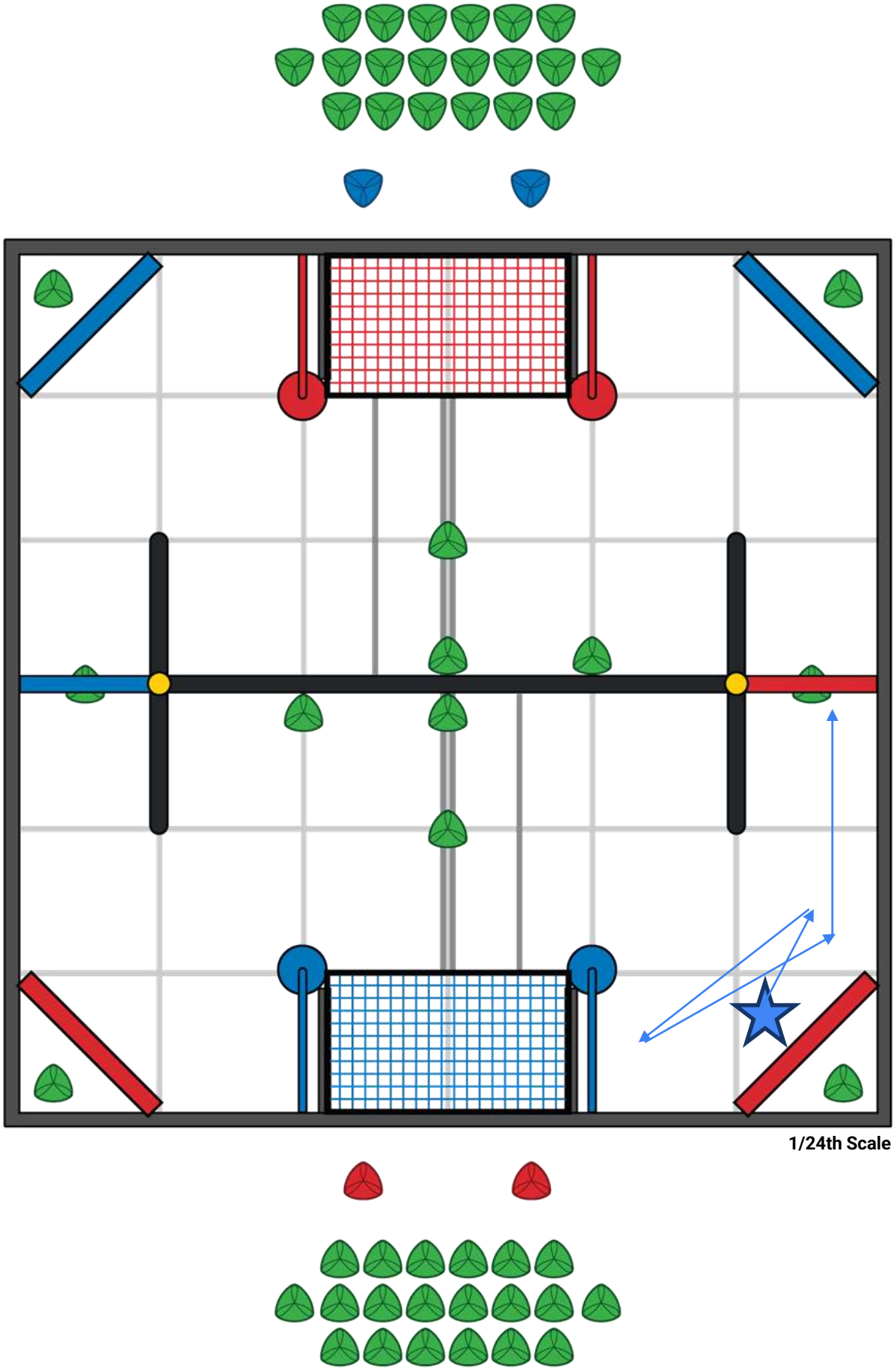


1/24th Scale

Project

Name Date Page 68

Autonomous L2

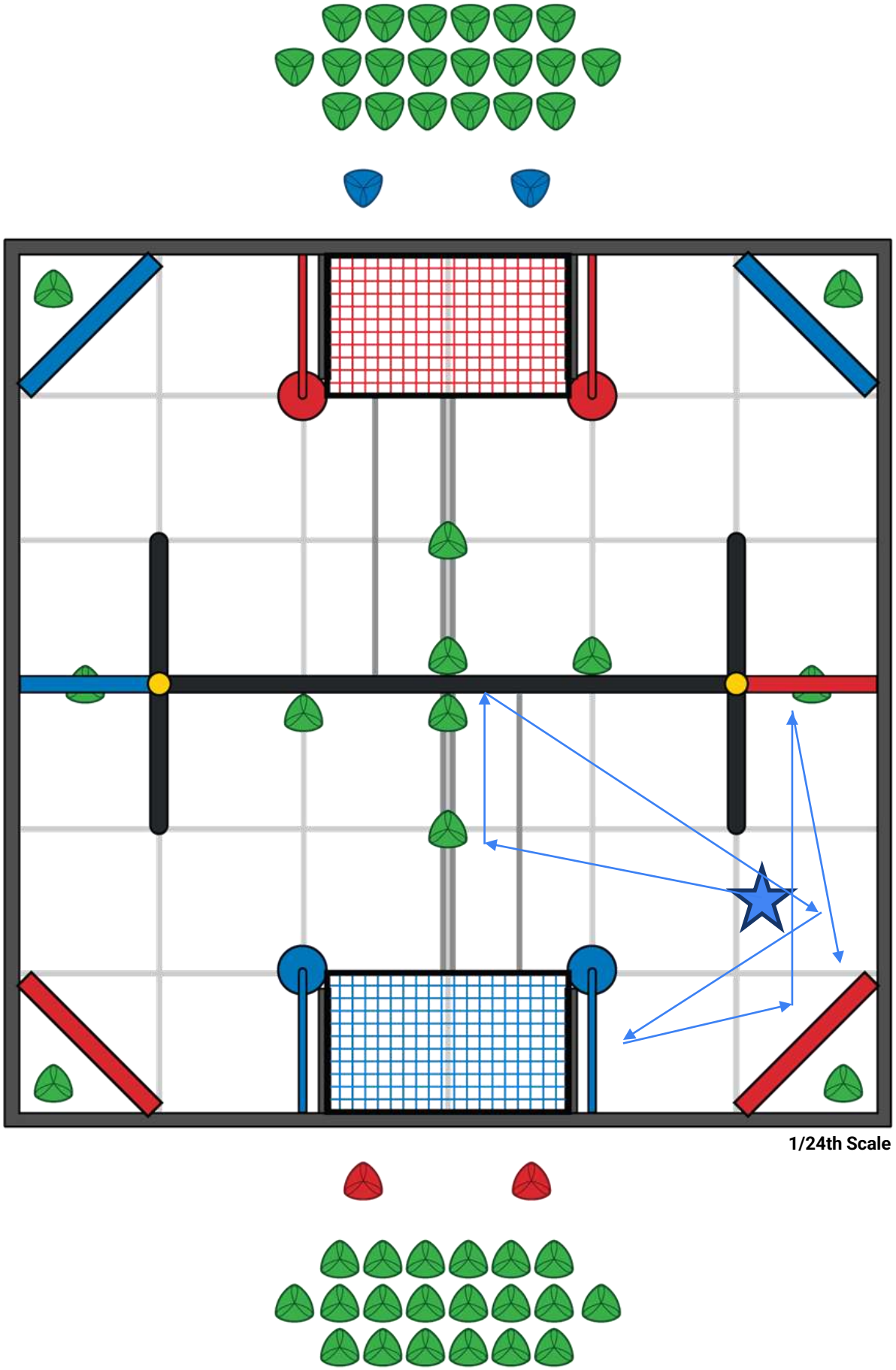


1/24th Scale

Project

Name Date Page 69

Autonomous L3



1/24th Scale

Project

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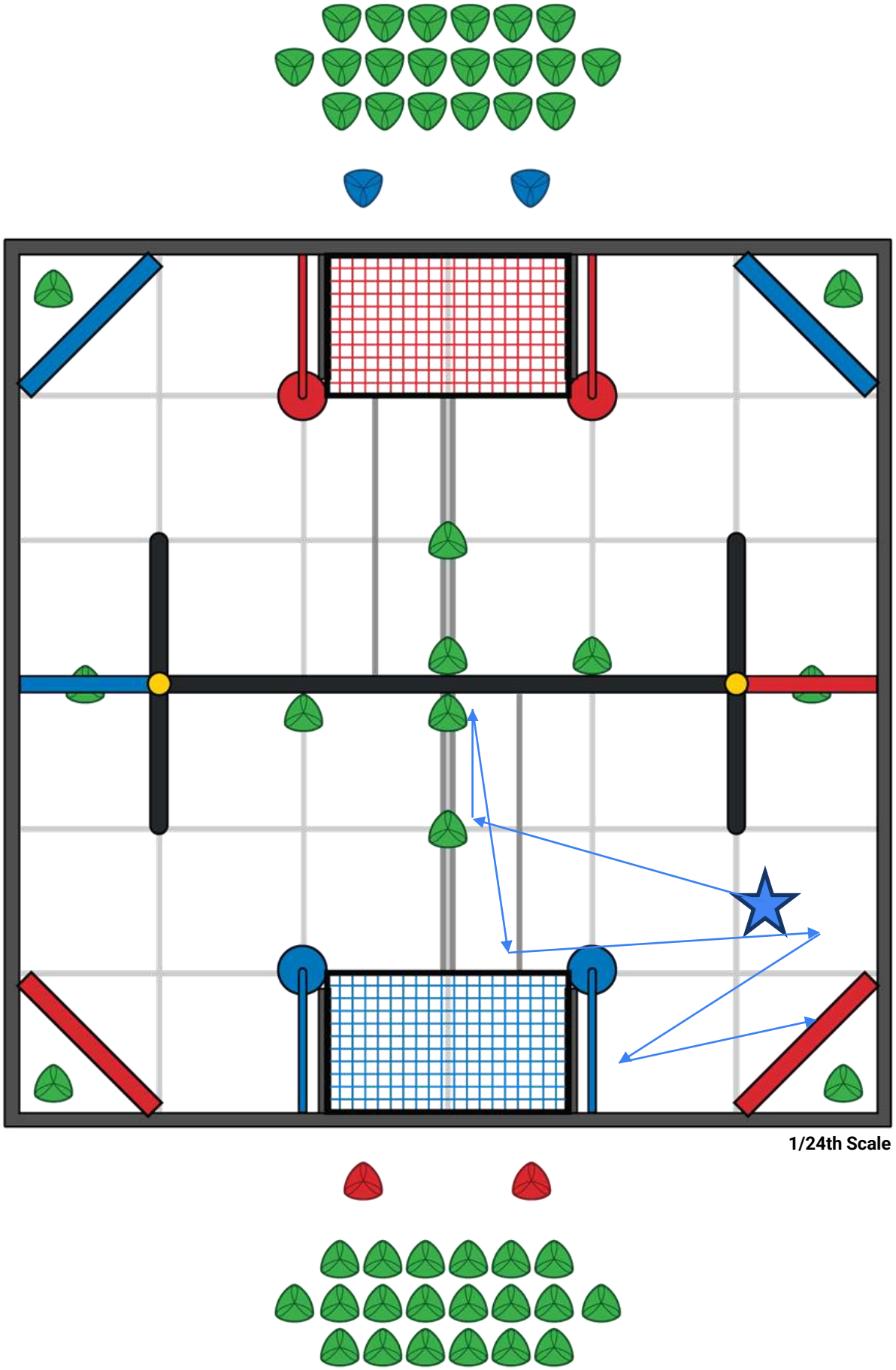
Autonomous L4



1/24th Scale

Project

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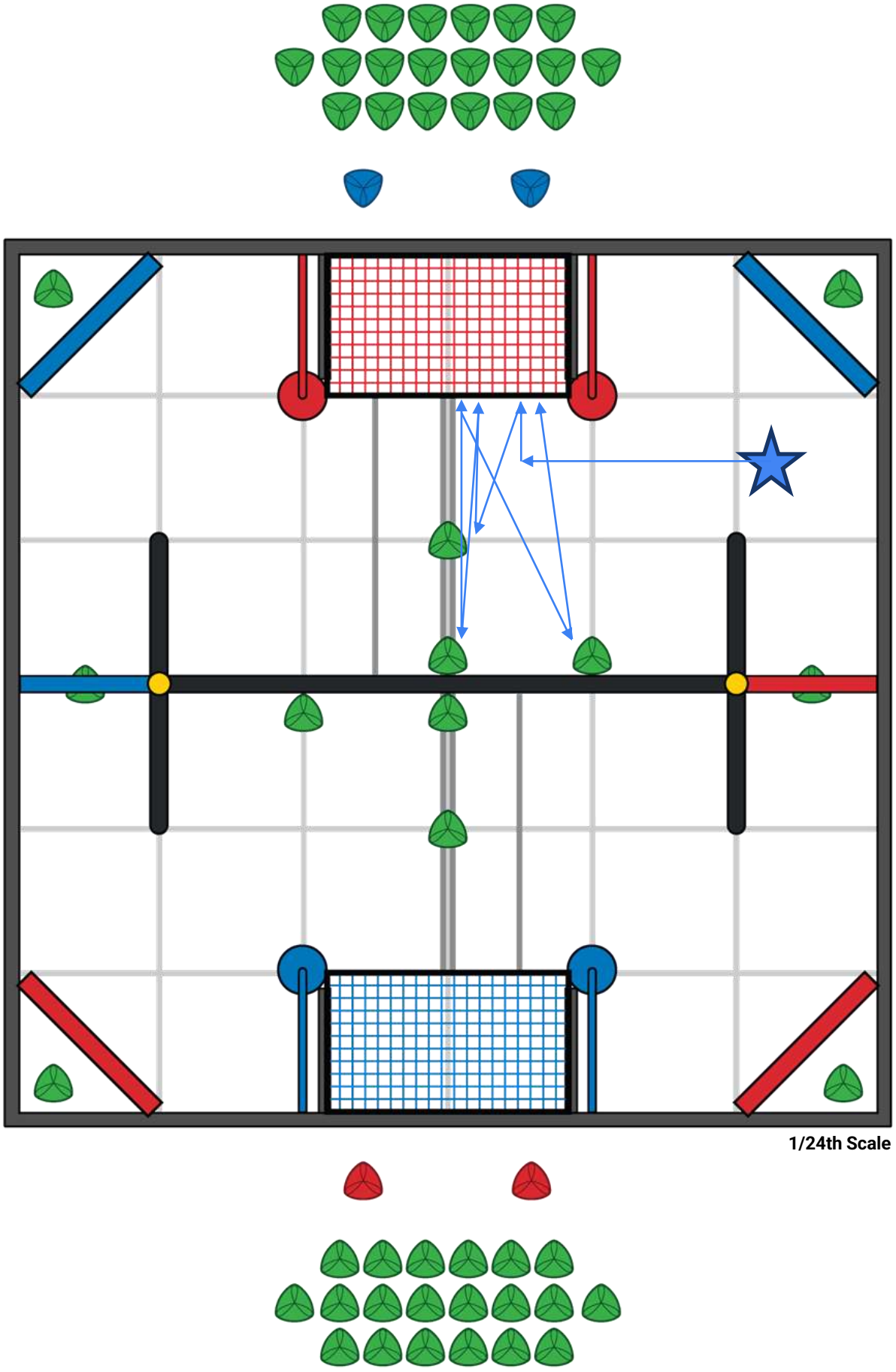
Autonomous R1



1/24th Scale

Project

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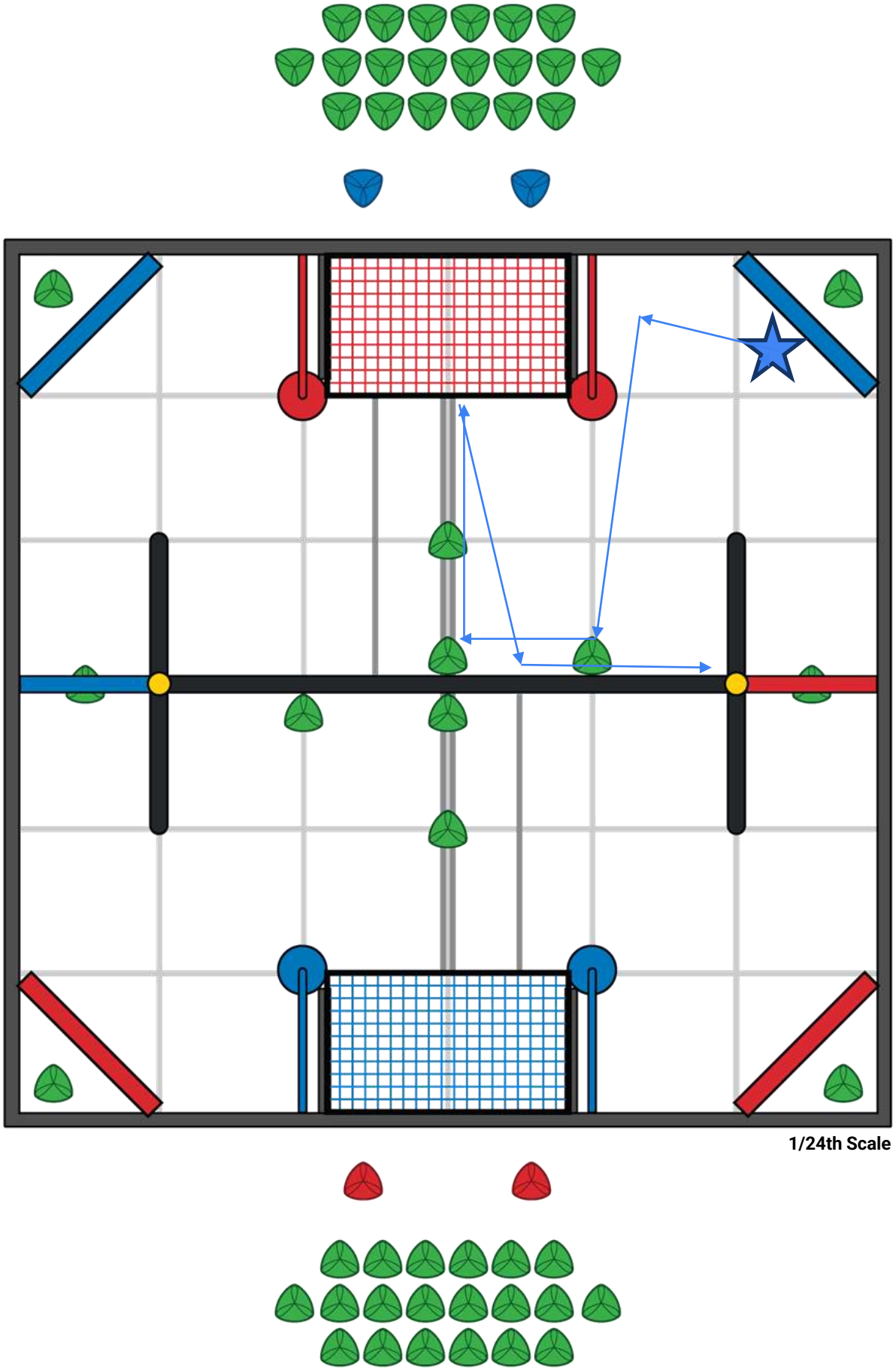
Autonomous R2



1/24th Scale

Project

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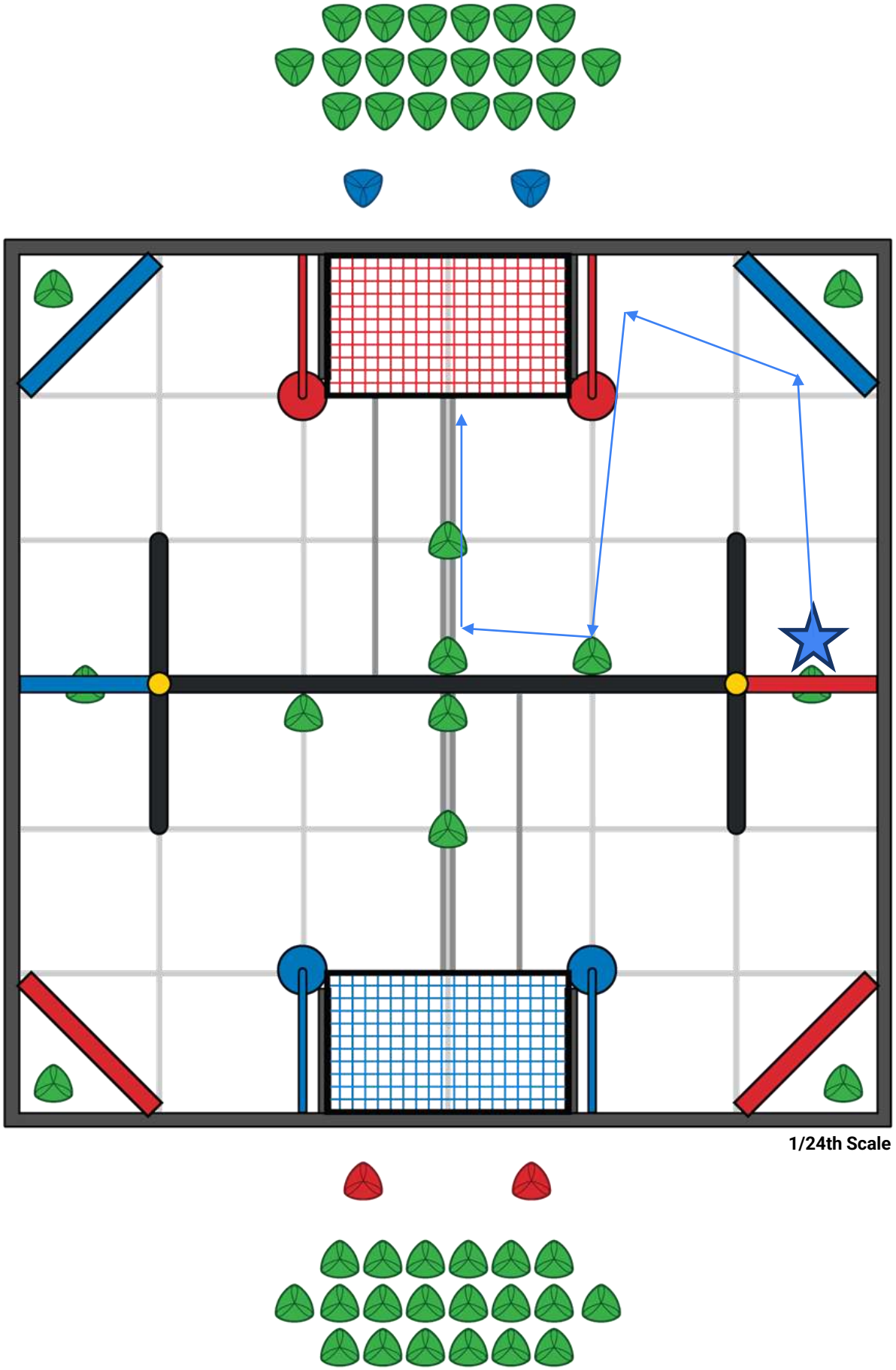
Autonomous R3

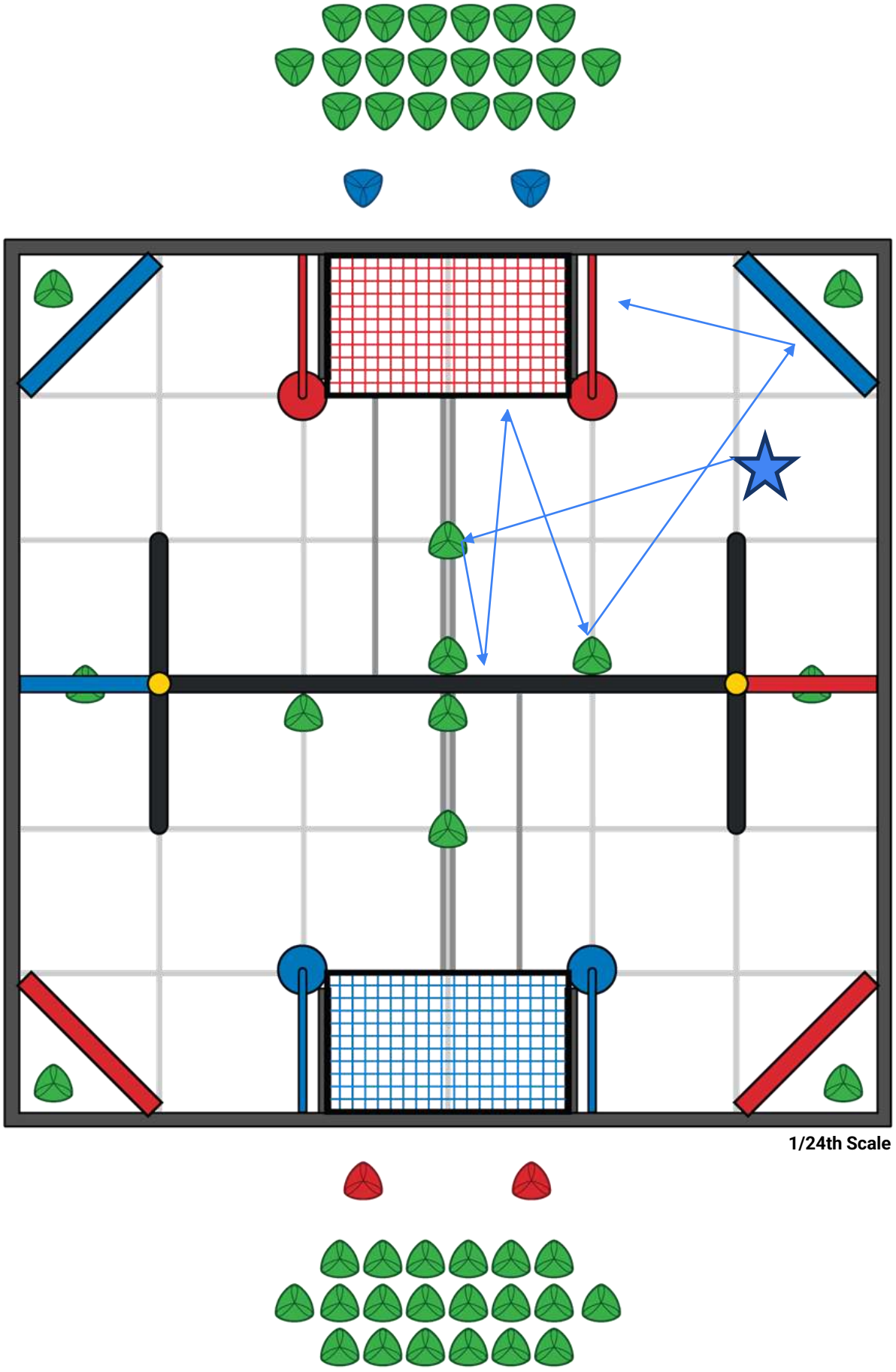


1/24th Scale

Project

Name Date Page 74

Autonomous R4



1/24th Scale

Project

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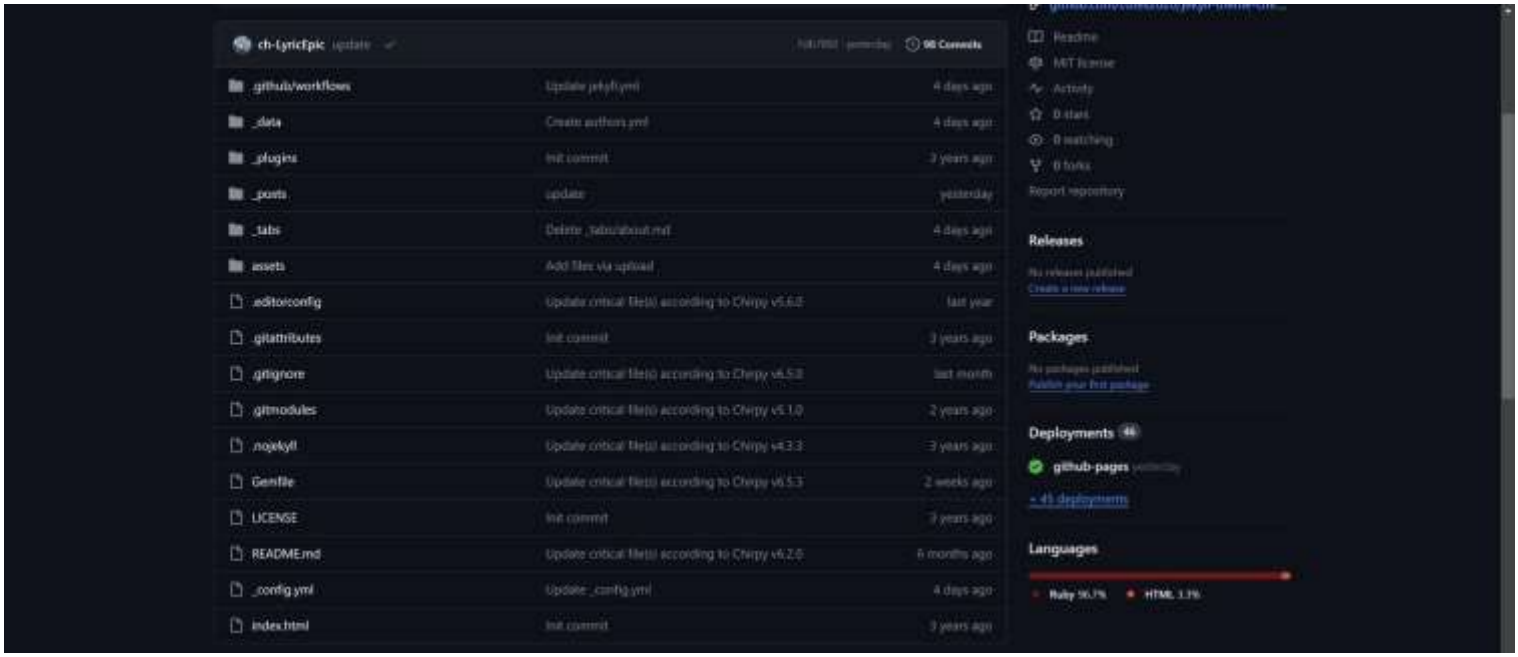
Part V

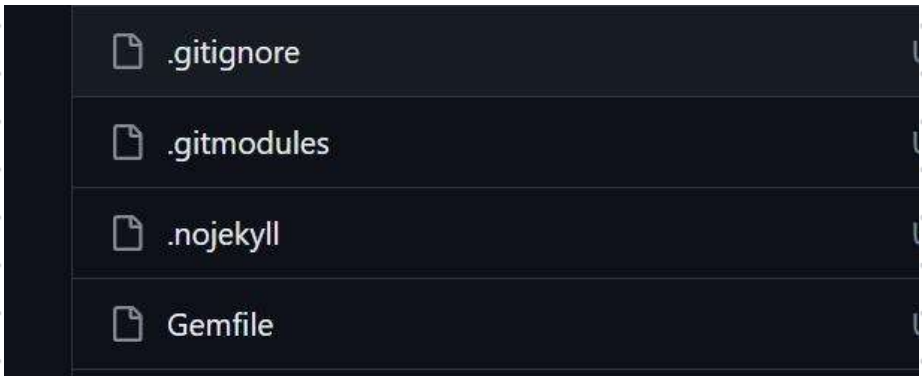
PID PROGRAMMING & ENGINEERING NOTES MANAGING

- **>ENGINEERING-NOTE-WEBSITE DEPLOY RECORD**
- *In response to the online meeting request on March 20th, our team has decided to deploy a copy of the Engineering notes on the website.*
- *Our first thought was to deploy using Github Pages, as this website only requires online viewing and categorization of our Engineering notes. Github Pages is a static website hosting service that does not require us to purchase servers or domain names, making it relatively cost-effective. So we created an exclusive Github account for the team 7925X to deploy Github Pages.*

- >ENGINEERING-NOTE-WEBSITE DEPLOY RECORD
- *After screening, we have decided to use the Chirpy template based on the Jekyll, provided by user @Cotes2020 for the [vex7925x.github.io] website. This template is powerful, easy to deploy, and has a high degree of customization while being concise. Considering that we don't need to do too much custom design, we directly used the Template's Chirpy Starter and copied it directly to the fork github@vex7925x . Then used [git Clone] to start the starter locally, configure the configuration file config.yml, set authors.yml, uploaded the website icon and other basic deployment work, and then pushed it to the target site.*

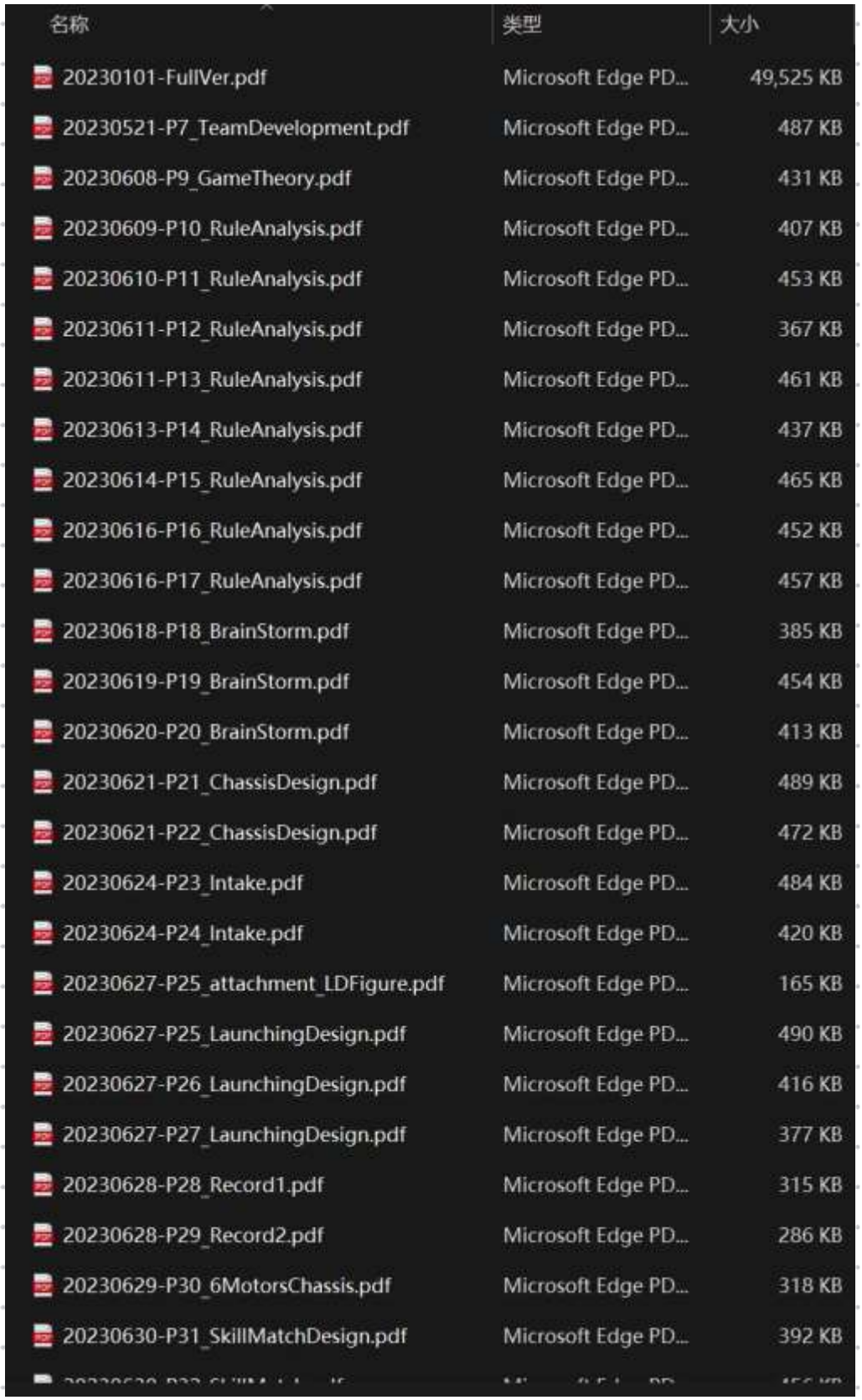


- **>ENGINEERING-NOTE-WEBSITE DEPLOY RECORD**
- *After pushing to Github Pages, we use Jekyll for Deploy&Build work. In order to be compatible with Chirpy Template, we declared [nojekyll] during deployment, which means we will not use the jekyll file generated by Github's built-in Jekyll deployment website and will replace it with a file we have written by ourselves. At this point, the basic framework of the website has been built.*



- *Due to some differences in content, layout, and other aspects between our electronic Engineering Note and entity Engineering Note, we believe it is best to upload the electronic version of the entity Engineering Note instead of the original file. Therefore, we used a scanner to scan our first entity Engineering Note Book in school, and then split the scanned full PDF page by page. This not only makes it easy to break down to dates, establish index directories, but also reduces loading pressure.*

- >ENGINEERING-NOTE-WEBSITE DEPLOY RECORD

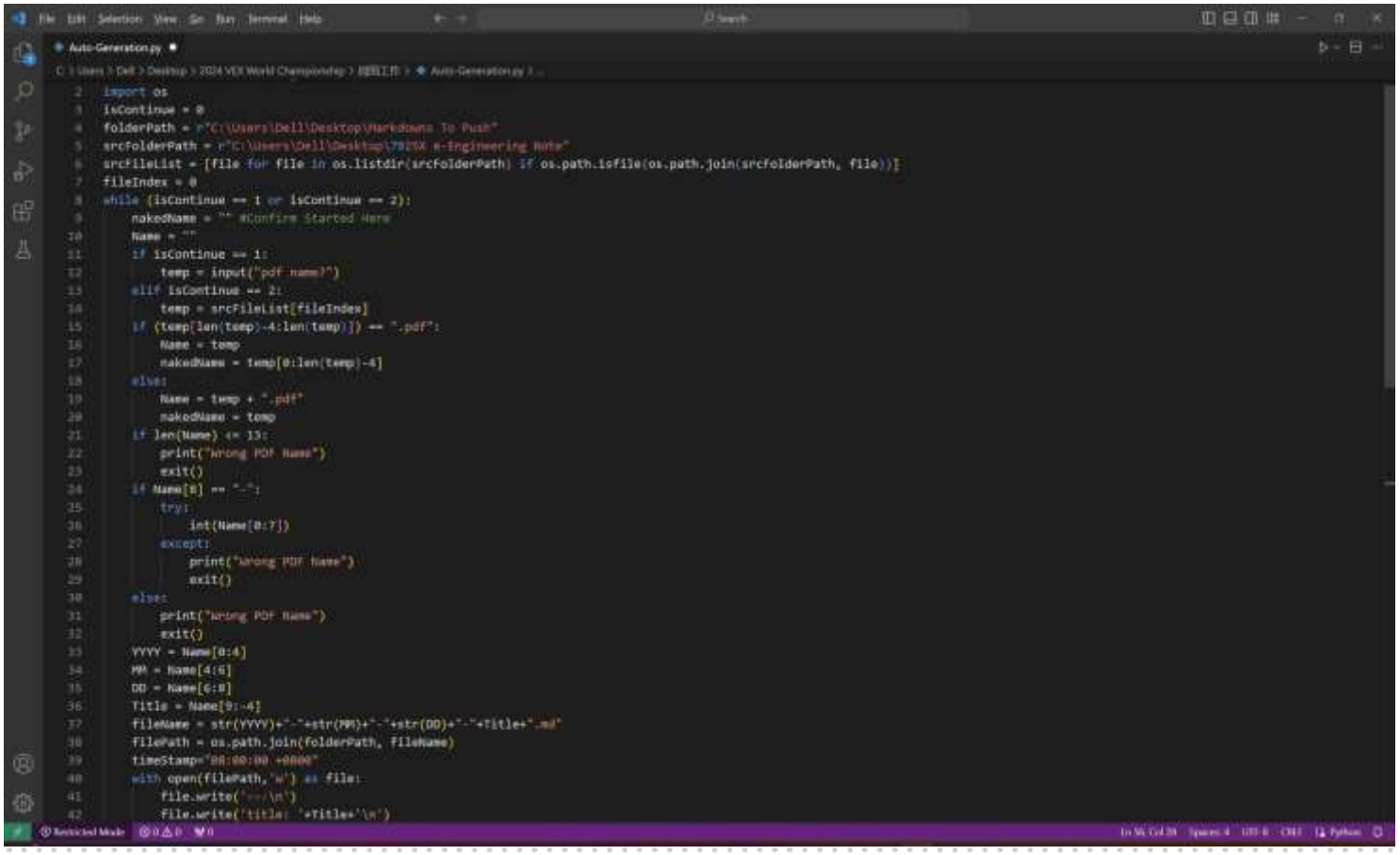


名称	类型	大小
20230101-FullVer.pdf	Microsoft Edge PD...	49,525 KB
20230521-P7_TeamDevelopment.pdf	Microsoft Edge PD...	487 KB
20230608-P9_GameTheory.pdf	Microsoft Edge PD...	431 KB
20230609-P10_RuleAnalysis.pdf	Microsoft Edge PD...	407 KB
20230610-P11_RuleAnalysis.pdf	Microsoft Edge PD...	453 KB
20230611-P12_RuleAnalysis.pdf	Microsoft Edge PD...	367 KB
20230611-P13_RuleAnalysis.pdf	Microsoft Edge PD...	461 KB
20230613-P14_RuleAnalysis.pdf	Microsoft Edge PD...	437 KB
20230614-P15_RuleAnalysis.pdf	Microsoft Edge PD...	465 KB
20230616-P16_RuleAnalysis.pdf	Microsoft Edge PD...	452 KB
20230616-P17_RuleAnalysis.pdf	Microsoft Edge PD...	457 KB
20230618-P18_BrainStorm.pdf	Microsoft Edge PD...	385 KB
20230619-P19_BrainStorm.pdf	Microsoft Edge PD...	454 KB
20230620-P20_BrainStorm.pdf	Microsoft Edge PD...	413 KB
20230621-P21_ChassisDesign.pdf	Microsoft Edge PD...	489 KB
20230621-P22_ChassisDesign.pdf	Microsoft Edge PD...	472 KB
20230624-P23_Intake.pdf	Microsoft Edge PD...	484 KB
20230624-P24_Intake.pdf	Microsoft Edge PD...	420 KB
20230627-P25_attachment_LDFigure.pdf	Microsoft Edge PD...	165 KB
20230627-P25_LaunchingDesign.pdf	Microsoft Edge PD...	490 KB
20230627-P26_LaunchingDesign.pdf	Microsoft Edge PD...	416 KB
20230627-P27_LaunchingDesign.pdf	Microsoft Edge PD...	377 KB
20230628-P28_Record1.pdf	Microsoft Edge PD...	315 KB
20230628-P29_Record2.pdf	Microsoft Edge PD...	286 KB
20230629-P30_6MotorsChassis.pdf	Microsoft Edge PD...	318 KB
20230630-P31_SkillMatchDesign.pdf	Microsoft Edge PD...	392 KB

- **>ENGINEERING-NOTE-WEBSITE DEPLOY RECORD**
- *The original plan was to upload the split PDF to the repository corresponding to Github Pages and embed it within the site using the label <iframe>. But later it was discovered that Github sets disabled <iframe> labels' resource calls, and an attempt was made to find that the way Raw Resources were called by [raw.githubusercontent.com] was also ineffective, returning data of 404. Therefore, we ultimately applied for a private CDN to implement the hosting of PDFs.*
- *In the subsequent PDF references, the access address of the CDN we applied for, used the HTTP protocol, while Github Pages used the HTTPS protocol. Obviously, different protocols cannot call resources. Considering that Github Pages service is quite unique and has certain limitations, we contacted the administrator of CDN and, through mutual cooperation, we granted CDN a one-year HTTPS protocol certificate. In addition, we have incorporated mandatory HTTPS and adaptive protocol declarations in the server-side header. At this point, the iframe was successfully used to embed the PDF.*

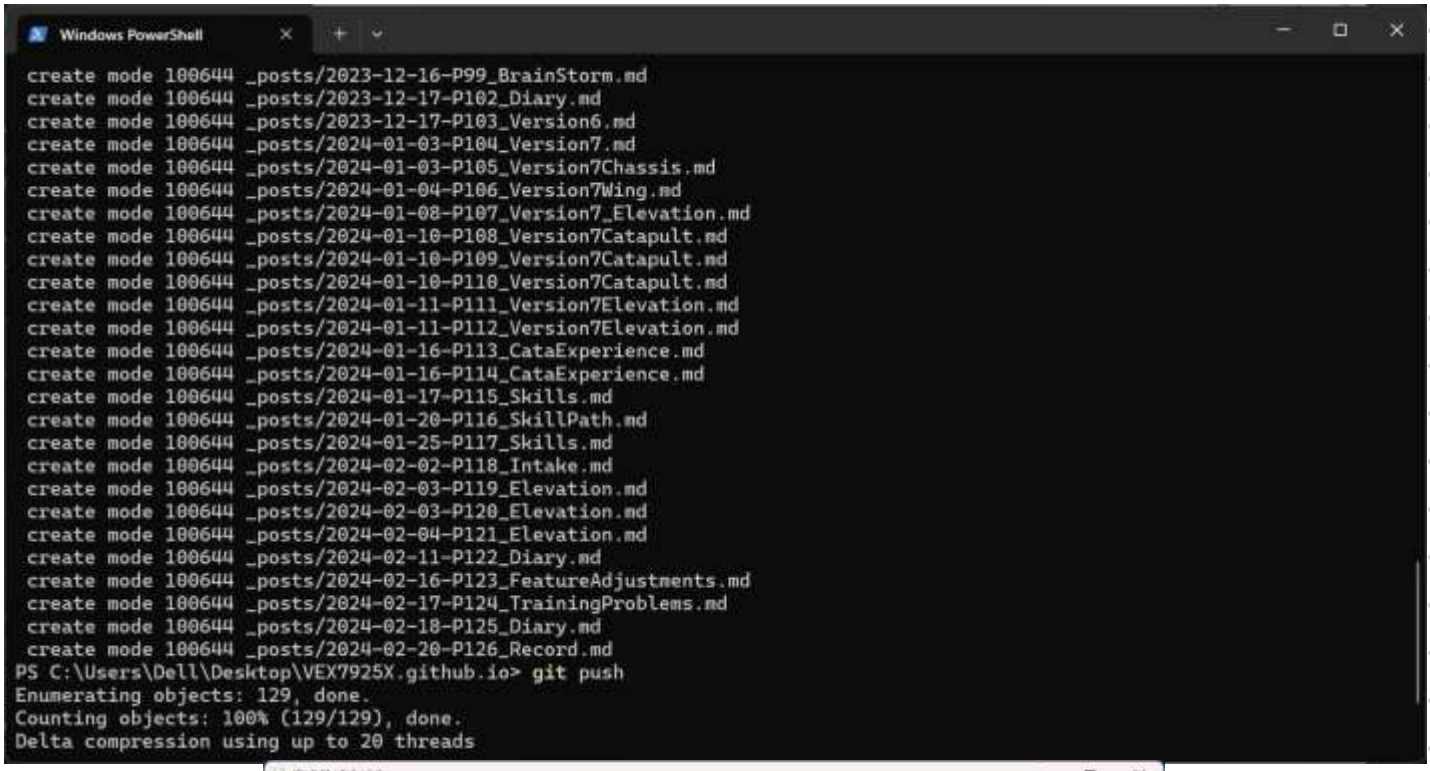
- **>ENGINEERING-NOTE-WEBSITE DEPLOY RECORD**
- *Then new problems emerged one after another. Our website is designed in the form of posts, similar to a team blog. In addition, we hope to split the PDF, so we need to complete 130 instruction files for each single page PDF (in Markdown format, mainly indicating the PDF address referenced in the post, the author (of course, this is "7925X"), upload time, theme, and other content). Our CDN server is located in California, USA, so loading the entire PDF directly would take up a lot of time (this PDF has a file size of 60MB!!).*
- *When scanning the PDF split, I have named each single page PDF one by one, in the format [YYYYMMDD-Page-Theme.pdf]. For example, on May 27 2023, we wrote the first article "Team Building" on page 7 of the Engineering notes, so the PDF on that page is named [20230521-P7-TeamDevelopment]. This basically meets the need for Markdown documentation, and my naming format is consistent. Therefore, I designed a Python program that can automatically read and process PDF file names, and generate Markdown documentation files.*

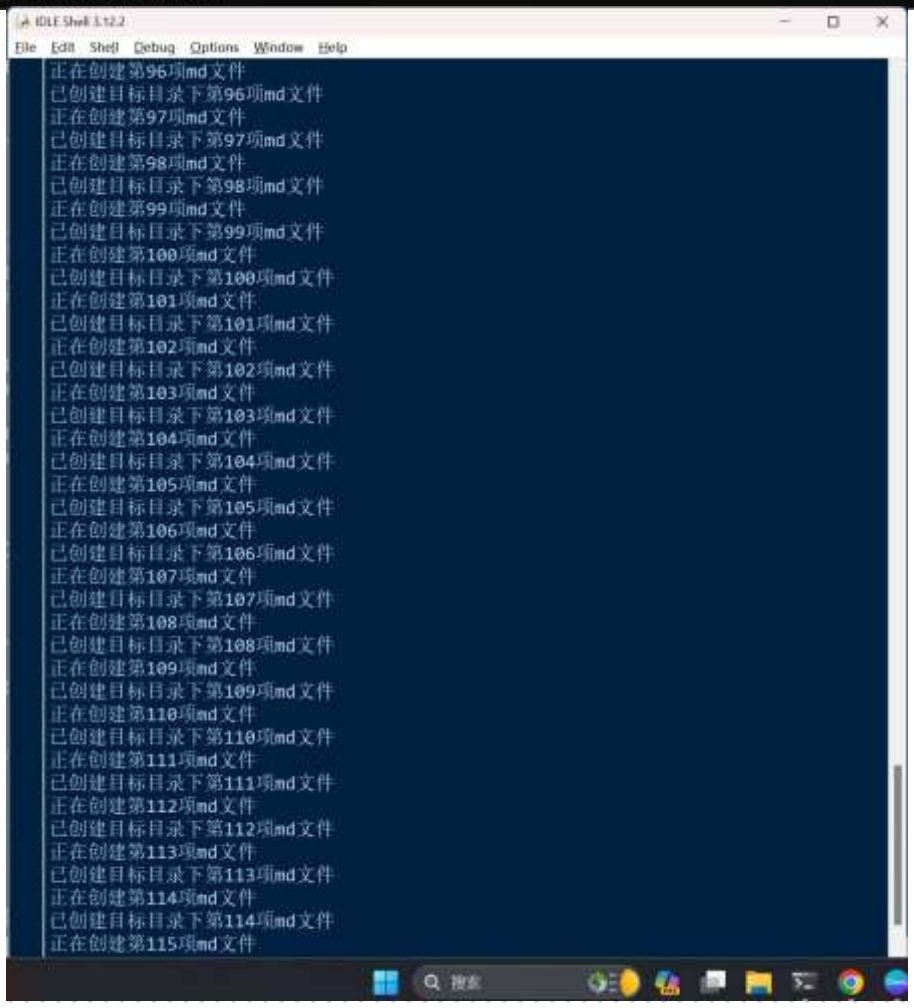
- **>ENGINEERING-NOTE-WEBSITE DEPLOY RECORD**
- The code excerpt is as follows:
- *YYYY = Name[0:4]*
- *MM = Name[4:6]*
- *DD = Name[6:8]*
- *Title = Name[9:-4]*
- *fileName = str(YYYY)+"-"+str(MM)+"-"+str(DD)+"-"+Title+".md"*
- *filePath = os.path.join(folderPath, fileName)*
- *timeStamp="08:00:00 +0800"*



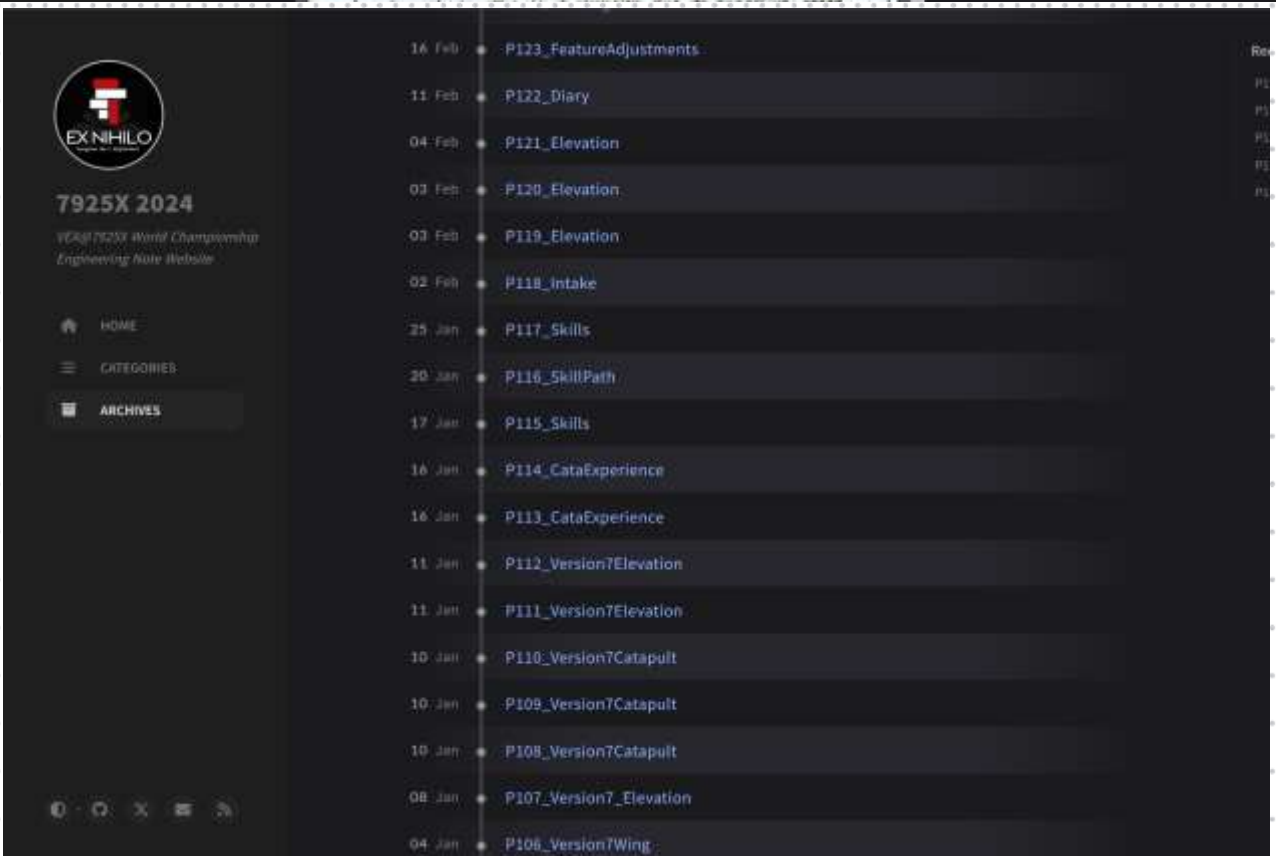
- **>ENGINEERING-NOTE-WEBSITE DEPLOY RECORD**
- *The code above uses Python's substring reading operation. Due to the fixed PDF name format, the creation date and its title (page number+topic) can be directly read from the substring. Then, a simple string concatenation was used to obtain the name of the Markdown documentation file, and the corresponding file generation directory was obtained using the Python standard library [OS]. This Python program also uses the [try... except] statement and has functions such as automatic one click operation to read directories, verifying the validity of PDF names, etc., to prevent program errors caused by manual naming or copying and pasting.With the help of the program, I didn't need to manually complete the mechanical labor of creating MD files for each PDF. The program quickly helped me complete the above work in 3 seconds and passed the compilation in one go when pushing to the site.*

- >ENGINEERING-NOTE-WEBSITE DEPLOY RECORD

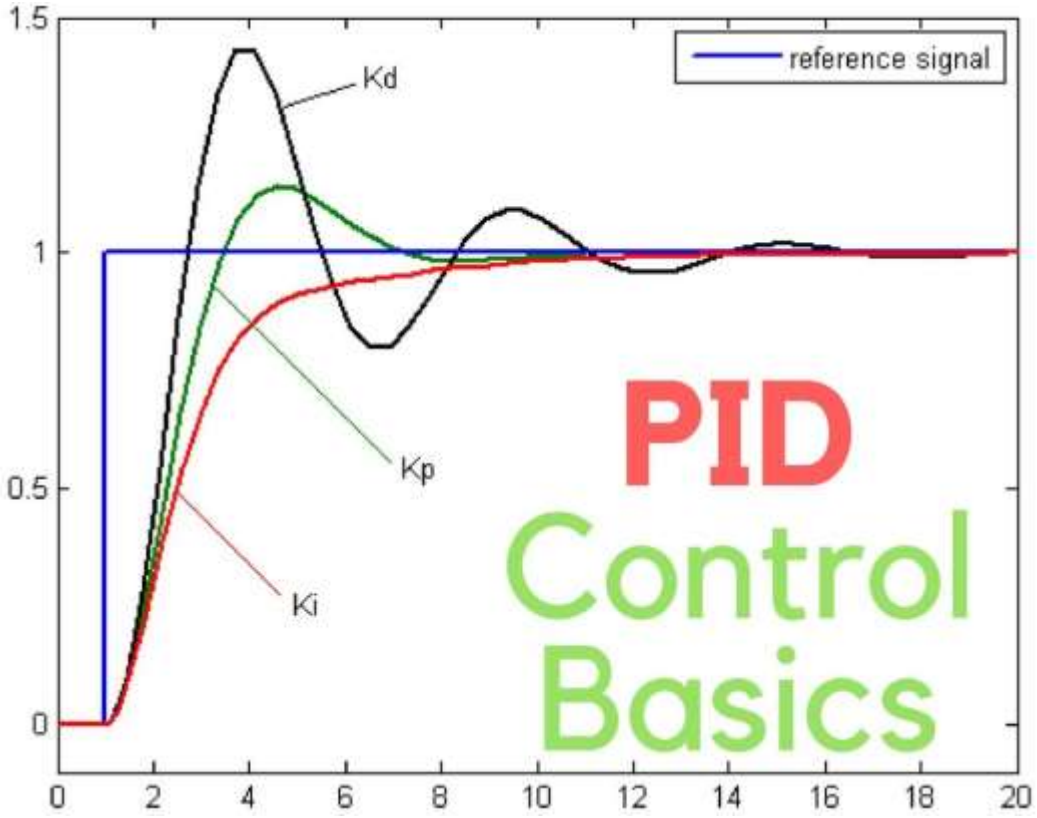




- **>ENGINEERING-NOTE-WEBSITE DEPLOY RECORD**
- *So far, the 7925X team's Engineering notes online website has been successfully deployed.*



- **>PID PROGRAMMING**
- *The examples in this Engineering note are from another article by web-author @StrongerHuang.*
- *PID controllers have been around since the late 1930s, and they were the only control method available at the time, except for switching controls applied in the simplest cases. PID is Proportion, Integral, Derivative three words' first letter, a control algorithm. The practical application of PID in the field other than VEX is quite extensive. Quadcopter, balance vehicle brain, car cruise controller, 3D printer temperature controller... PID is useful in situations where a physical quantity needs to be "kept stable".*

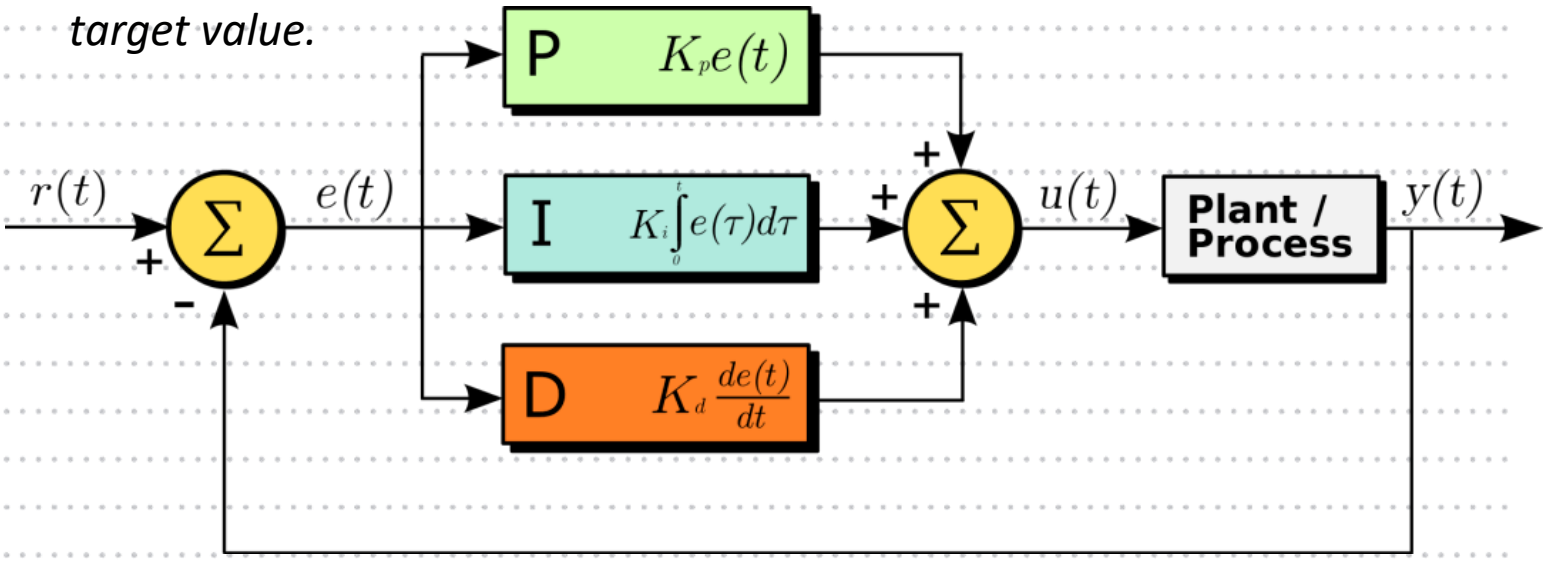


- **>PID PROGRAMMING**
- *The practical application of PID in the field other than VEX is quite extensive. Quadcopter, balance vehicle brain, car cruise controller, 3D printer temperature controller... PID is useful in situations where a physical quantity needs to be "kept stable" (such as maintaining equilibrium, stabilizing temperature, speed, etc.).For example, if I'm boiling water and I want to keep the water temperature at 50 degrees Celsius, why do I need to use calculus for such a simple task? Less than 50 degrees than let it heat up, more than 50 degrees than power off, The simplest operation that can be solved with a few lines of code. In the case of low demands, such a rough way is actually no problem. But if you change the situation to a more dangerous situation, you can see what the problem is: if I am not controlling hot water, but a car, and it is required to keep its speed at 50km/h. If the car's cruise controller test at a certain time measured the speed of 45km/h, so the engine accelerated immediately, the engine increased the horsepower, opened to 100% full throttle, a few seconds of time the car accelerated to 80km/h. So after a few seconds, the detector issued a brake instruction! So reciprocating, the car will speed up and slow down, cause serious consequences.*

- **>PID PROGRAMMING**
- *Therefore, the simplest diode type 01 switch does not work properly in real life. We must calculate the necessary delay for the control object, the execution unit, the information transfer unit, and so on. Moreover, the control object has inertia, for example, if you unplug a heater, its thermal inertia, which is what we often say is the residual temperature, will continue to increase the water temperature for a while. At this time, an algorithm is needed: it can bring the physical quantity to be controlled near the target. It can "foresee" the change trend of this quantity. It can also eliminate static errors caused by heat dissipation, resistance and other factors. Then the PID algorithm is introduced. PID is three different adjustment effects, can be used alone (P/I/D), can be used in two (PI/PD), also be used in three (PID).*

- **>PID PROGRAMMING**
- *Let's first talk about the basic parameters of PID controller.*
- *kP: Proportional. A quantity that needs to be controlled. In the actual writing of the program, let Delta(=target-current) and the adjustment of the "adjustment force" of the adjustment device, establish a relationship between a function, you can achieve the most basic "proportional" control. The larger the kP, the more radical the regulatory effect, and the smaller the kP will make the regulatory effect more conservative.*
- *kD: Derivative. In terms of VEX robots, for example, we often need to complete tasks: advance the specified distance, turn the specified Angle, with the role of P, the vehicle will "shake" back and forth near the balance value, and it is difficult to stabilize. We need a control action so that when current is closer to target, P has less control. The closer you get to target, the smaller the effect of P. There are many internal or external factors that cause the control quantity to swing in a small range. The function of D is to make the velocity of the physical quantity approach 0, and as long as the quantity has a velocity, D can exert force in the opposite direction and try to brake the change. The larger the kD parameter, the stronger the braking force in the opposite direction of the speed*

- **>PID PROGRAMMING**
- *kI: Integral. According to the algorithm design, P algorithm will think that current and target value are already very close, and only need to gently adjust it. D algorithm thinks that increasing and decreasing are equal, there is no fluctuation, and D don't seem to have to adjust anything. At this point, you can set an integral component. As long as the deviation exists, the deviation is continuously integrated (accumulated) and reflected in the adjustment force. In this way, even if the difference is not much, but over time, as long as the target is not reached, the product component will continue to increase, and the system will increase power. Once the target is reached, assuming it does not fluctuate, the integral value will not change again. The larger the value of kI, the larger the multiplier coefficient during integration, and the more obvious the integration effect. So the role of I is to reduce the error in the static case, so that the controlled physical quantity is as close as possible to the target value.*



- **>PID PROGRAMMING**
- *That's how we use PID algorithm to control our robot:*
- *1. Set Target: The target direction of the robot needs to be determined. Can be entered by remote control, automatic, etc.*
- *2. Determine Current: Use an inertial sensor (usually a gyroscope) to measure the current steering speed and direction;*
- *3. Calculate Delta: Delta=Target-Current;*
- *4. Calculate PID Output: P: Delta*kP gets the control output. I: Calculate the cumulative value of Delta, multiply by kI to eliminate Static_Delta. D: Calculate the rate of change of Delta, multiply by the differential constant kD to suppress the oscillation and accelerate the convergence.*
- *5. Calculate total output :P+I+D= total output;*
- *6. Apply the output value to the motor, cycle control and adjust.*

```
108 }
109
110 void driveDist(int dist,int speed,float robotDeg){
111   double kp = 0.45;
112   double ki = 0.001;
113   double kd = 0.001;
114
115   LM.resetPosition();
116   robotDeg = Inertial.rotation(deg);
117
118   double integral = 0;
119   double lastError = 0;
120
121
122   int direction = (dist >= 0) ? 1 : -1;
123
124
125
126   while(fabs(LM.position(deg))<abs(dist)){
127
128     float rotationRate = Inertial.rotation(deg);
129
130
131     float error =  robotDeg- rotationRate;
132
133
134     double correction = kp * error + ki * integral + kd * (error - lastError);
135
136
137     integral += error;
```

Team members

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DIGITAL NOTEBOOK

EXNIHILO
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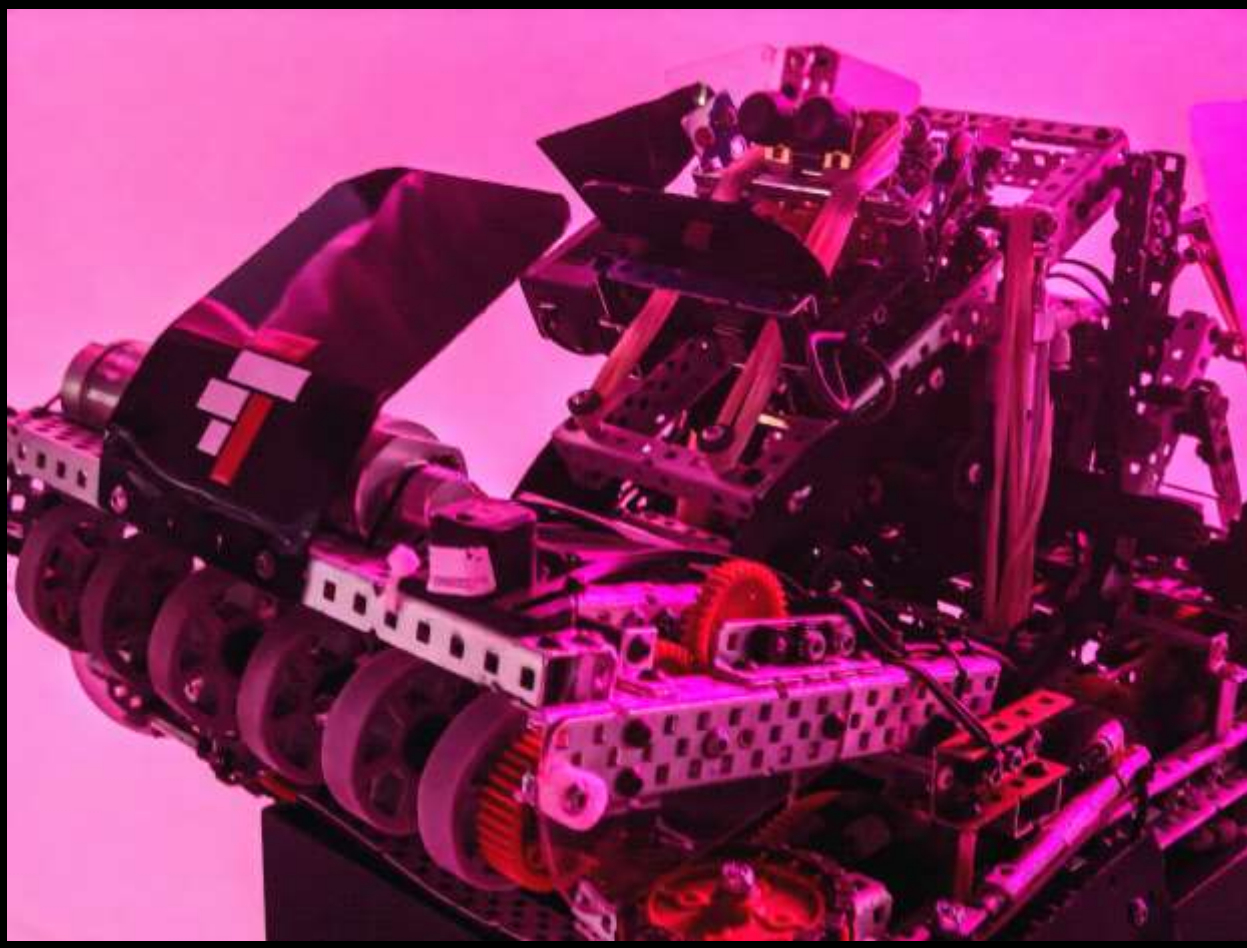

VEX ROBOTICS COMPETITION
OVER UNDER

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ENGINEERING NOTES 2 OF 2