2616E - Nothing Starstruck

ENGINEERING NOTEBOOK

2017-2018
6 7

2616E

TABLE OF CONTENTS

TABLE OF CONTENTS

TABLE OF CONTENTS

BOOK

TABLE OF CONTENTS

TITLE About 2616E PROJECT

Continued from Page

We are a team of 3 freshman putting our diverse skills together to create a well working team. All three of us joined September for Nothing but Net, where we learned the skills required to create a reliable and successful robot. Here is an overview of the members of our team and our individual tasks on the team:

Cameron Lund

Cameron is our teams builder, and also works with the teams programmer to create a strong link between hardware and software. He also puts together the teams CAD designs that will be shown throughout the notebook.

Ian White

Ian is our team's driver and strategizer. He takes the time to look over the game, and offer advice on how we can improve our robot to maximize scoring potential.

Michael Ryan

Michael is our team's programmer. He helps us win autonomous rounds by using a complex collection of sensors. He also offers advice on where we can build sensors into the robot to maximize their effectiveness.

Continued to Page

SIGNATURE Cameron Lund

DATE 5/4/2016

DISCLOSED TO AND UNDERSTOOD BY [illegible]

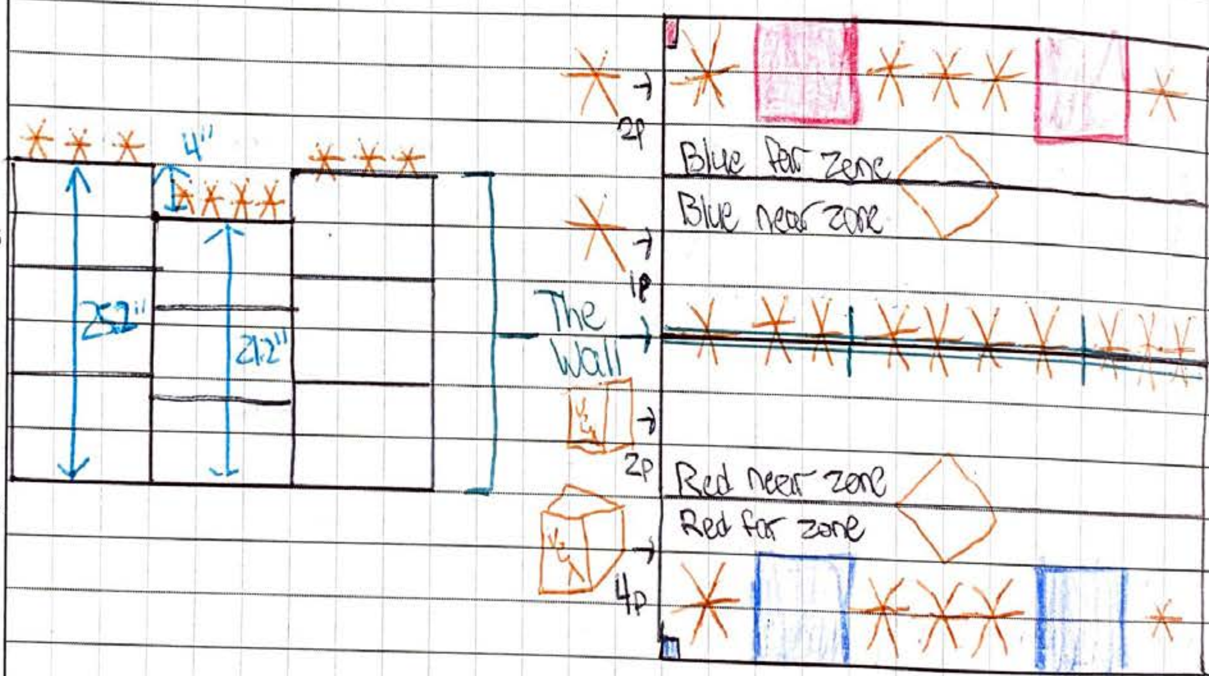
DATE 5/4/16

PROPRIETARY INFORMATION

TITLE Game Overview / Strategy **PROJECT**

Continued from Page

This year's game, Starstruck, is played on a field split into 2 equal areas by an ~25" wall in the center. These two sides are then equally split into two scoring zones, near and far (from the wall). There are 24 Stars (6 pointed) that are in play. 10 start on the ~~field~~ wall, 10 on the field, and 2 as preloads for each team. There are also 4 cubes in the game, 2 on field and 2 as game loads in the last 30 seconds. Stars are worth 1 point in a near zone, and 2 in a far. Cubes are worth 2 points in a near zone, and 4 in a far.



The object of this year's game is to score more points. The 3 available ways to do this are 1) Scoring game objects 2) Auton bonus 3) Hanging. For scoring game objects, we immediately saw two successful strategies to win, "Blitz" and "Maintain"

Continued to Page 3

SIGNATURE Cameron L DATE 5/4/2016

DISCLOSED TO AND UNDERSTOOD BY Michael Myer DATE 5/5/16

PROPRIETARY INFORMATION

TITLE Game Overview / Strategy PROJECT

Continued from Page 2

"Blitz"

The idea of this strategy is that you hold as many objects as possible until the last few seconds, then dump them when there's not enough time for the other team to descore. In theory this is a great strategy, but it has some flaws. The first and most major obstacle is being able to hold enough objects for the strategy to be effective. Another flaw is that if a robot blocks you and since you have little time, you are stuck with the objects on your side.

"Maintain"

The idea of this strategy is that you have a faster intake and launcher than the opposing team maintaining a constant return fire while keeping your side clear. With this strategy it's important to remember that getting to the far zone isn't very important as long as you can keep the game objects off of your starting side/the opposing teams scoring zone. A flaw with this design is that if the other team is faster, you have no counter.

Strategies to win autonomous are tricky, because your ally is always a big question mark. Because of this, it's super important to have multiple auton modes to avoid conflicts like collisions. For autonomous, there are 3 major ways to score: 1) Launch preload and field objects 2) clear the fence 3) Hang. We think the most valuable options are one and two, as they will help you get a head start. Also, you can combine options one and two by using game objects to shoot others off the fence. Although one and two should be a primary, option 3 is a good backup if your ally will be ~~hanging~~, going for the wall.

Continued to Page

SIGNATURE Cameron L

DATE 5/4/2016

DISCLOSED TO AND UNDERSTOOD BY Michael Ryan

DATE 5/5/16

PROPRIETARY INFORMATION

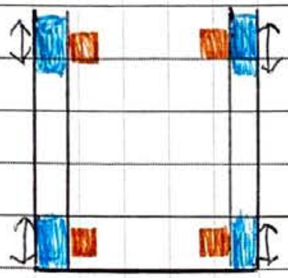
PROJECT

TITLE Drive Overview

Continued from Page

We have decided that this year a holonomic drive is the way to go. Strafing will help speed up tasks like intaking the starting stars since you can avoid making turns. Also, with the complex shape of the stars, strafing will make it easier to make minor left/right adjustments for intaking.

Omni Wheel | Mecanum Wheel | Motor | Wheel Orientation

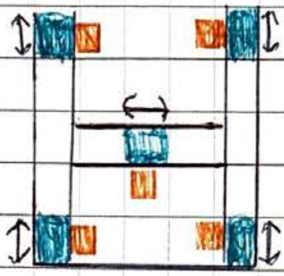


Mecanum Drive

The mecanum drive uses a set of wheels that have small rollers at 45° angles. When both motors on the same side run the same direction, it acts like a tank. When they go against eachother, you can strafe and go diagonal.

Pros: • Wide open front
• Wide open center

Cons: • Reduced power when doing non tank drive movements
• Thicker than H-drive

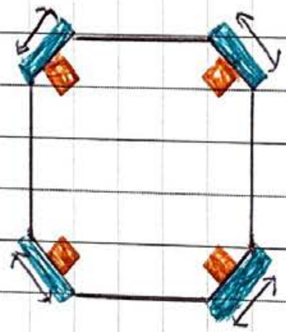


H-Drive

Same as a normal tank drive, with an added center wheel. To strafe, the center wheel spins left/right

Pros: • Drives like a tank
• Easy build/program

Cons: • Takes 5 motors
• Uses up a lot of room



X-Drive

Four wheels, one on each corner at 45° angles. Moves ~1.414 times faster than motors.

Pros: ~~• Complex build~~
• Wide open middle
• Fast

Cons: • Complex build
• Restricted front opening

SIGNATURE Cameron L

DATE 5/4/2016

DISCLOSED TO AND UNDERSTOOD BY Michael Ryan

DATE 5/5/16

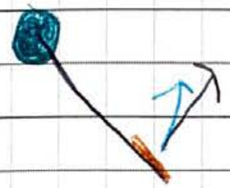
Continued to Page

TITLE Launcher Overview PROJECT

Continued from Page

The Objective of this year's game is to score objects on the other side of the fence. At its highest, the fence is 25.2" tall, a little over two feet. One method of getting game objects over this fence is by using a launcher. Instead of picking up and placing like a lift, this shoots the ~~ball~~ game object over the fence. This can be a lot faster than a lift, but a lot less concise. Also, it's hard to get the star objects in the same orientation every time for a shot.

Point of connection Contact with object Flight of object
(Drawings in primed position) Movement of launcher



Kicker

For Starstruck, a Kicker launcher would consist of an arm that when primed sits low enough to get under a star. It then makes a swift upward movement to launch it over the fence.

Pros · Easy build
· Intake not required

Cons · Hard to position the same way every time
· Short movement could be hard to get force with

Puncher

A puncher, normally built on a linear slide kit, uses a linear pullback then release assisted by elastics. With the stars this year, you'd likely need to hit them perfectly in the center.

Pros · Easy build
· Fast
· Small space taken up if built right

Cons · To hit right, consistent intake required
· Can't hit off the floor (not enough pull back room)

Continued to Page 6

SIGNATURE Cameron L DATE 5/5/2016

DISCLOSED TO AND UNDERSTOOD BY [signature] DATE 5/6/16

PROPRIETARY INFORMATION

TITLE Launcher Overview **PROJECT**

Continued from Page 5

Catapult

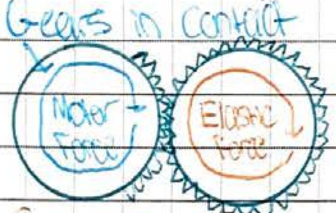
A Catapult typically pulls back with the Object and Moves forward until (optimally) 45° where the arm Stops moving and the Object carries the momentum. They can take a lot of tweaking to get working right; a lesson we learned the hard way from NBN

Pros:
· Can get a high angle to avoid getting blocked
· Can pick up off ground (if it goes back far enough)

Cons:
· Can be tricky to get angles correct
· Can be hard to stop it's momentum without bending metal

All of these typically get their force from elastics, and use a pull-and-release method to prime them. The popular designs of this type include slip gears and nautilus gears. Some people use motors to pull back then elastics and motors together forward, although this can limit speed and put unnecessary strain on the motors.

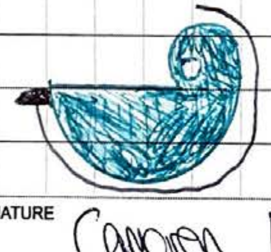
Gears in contact



Gears in slip

Slipgear

A slip gear setup consists of a driven gear (the slip) and a gear pulled by elastics (attached to arm). When the gears are in contact the motor pulls the elastic gear stretching them, and when it gets to the slip the elastics are freed to fly back to resting position at a high speed, launching the object



Nautilus Gear

A nautilus gear setup consists of a slide being pulled toward the gear by elastics. As the gear rotates, the distance from the axle increases pushing the slide back until the stop, letting the slide fly forward

Continued to Page

SIGNATURE Cameron L DATE 5/15/2016

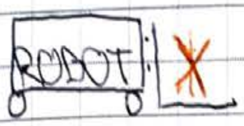
DISCLOSED TO AND UNDERSTOOD BY Jen White DATE 5/6/16

PROPRIETARY INFORMATION

TITLE Intakes Overview PROJECT

Continued from Page

Intakes are sometimes required when working with the game objects. This is especially prevelant when using a lift to manipulate objects, or if you want to move objects around the field. With the complex shape of this year's stars it's difficult to get hold on them. Here are the popular ideas for this year.

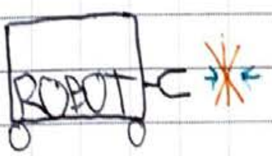


Forklift / Tray

These types of intakes simply go under the game objects and scoop them up.

Pros | · Super simple
· Can intake both objects
· Can intake multiple objects

Cons | · Can require many motors
· Slow
· Take up a lot of room.

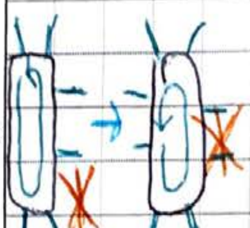


Claw / Gribber

These take advantage of the small areas in the center of the stars where it's relatively easy to grab. A claw or other gripper goes around this and closes in on it. They can also pinch on cubes to grab them.

Pros | · Simple
· Fast
· Can pick up both objects

Cons | · Can only pick up one object at a time



Chain intake

These use chains and sprockets to lift ~~Cubes~~ Stars. The chain has pegs sticking off that go under the pegs ~~to~~ of the star to pick them up.

Pros | · Fast
· Can intake many Stars
· Compact

Cons | · More complex than others
· Can't intake ~~Stars~~ Cubes
· Chain can ~~[illegible]~~ unlink making intake useless

Continued to Page

SIGNATURE Cameron L DATE 5/6/2016

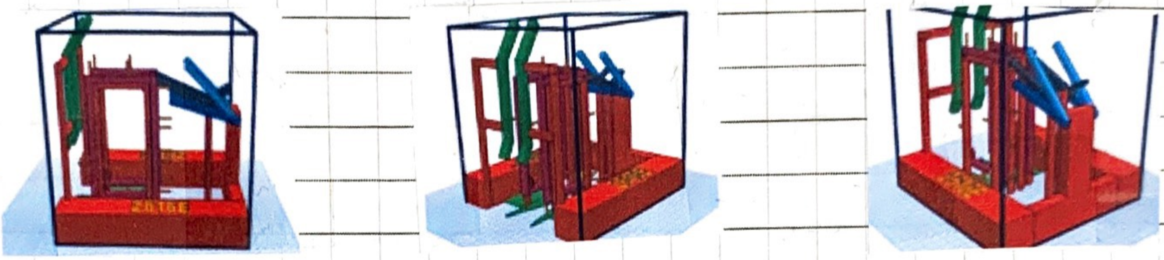
DISCLOSED TO AND UNDERSTOOD BY Michael Ryan DATE 5/6/16

PROPRIETARY INFORMATION

TITLE Robot design #1 **PROJECT**

Continued from Page

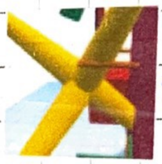
Over the weekend our team has deliborated on the best features for our robot, and we have made our design choices. We decided on a robot surrounding the aforementioned "Maintain" strategy. The following is a breakdown of the Major systems of our design and why we chose them.



The rough CAD of our robot from multiple views

Strategy: We chose to use the "Maintain" strategy for our first robot. We chose this because it has less risks than the "blitz" design (getting blocked, not dumping objects before round end). We also chose this design because it would be very difficult to build a robot capable of holding enough objects for the "blitz" strategy to be effective.

Intake: We decided to go with a chain intake for our robot. Although it cannot intake cubes, it can intake stars quickly and hold 2-3. Also, cubes could be placed on our launcher (game loads). This best suits our "Maintain" strategy because it allows us to quickly get stars into our launcher.



An example of the intake pegs (orange) picking up a star

A zoomed out view of the rough intake design

Continued to Page 9

SIGNATURE Cameron L. DATE 5/8/2016

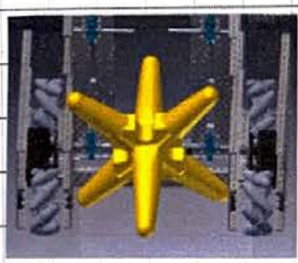
DISCLOSED TO AND UNDERSTOOD BY Michael [illegible] DATE 5/9/16

PROPRIETARY INFORMATION

TITLE Robot design #1 **PROJECT**

Continued from Page 8

Drive: We decided to go with a Meccanum drive. Since we are using a chain ~~drive~~, this drive gives us enough room to fit a star in the center of the robot. We considered the fact that there's torque loss when strafing, however since there's no risk of getting pushed we decided we would be fine. Also, with our costum design, we can have "gear ratios" with chain and sprocket, while only being 7 holes wide per side.



An example of a star fitting in our drive design

A view of our 7 hole Meccanum drive excluding the chain

Autonomous: With the above combination of systems, we have decided on the general autonomous design that knocks stars off of the fence with stars it picks up from the field. To do this, we plan to use a combination of a gyroscope and integrated encoders on our drive.

Launcher: Since we chose to knock stars off the fence, we decided to use a special kind of catapult that has variable tensioning. It uses surgical tubing attached to a moving assembly on a linear slide. To get more tension, the slide pulls down stretching the tube.

A view of our rough launcher design. Dark blue retracted, light blue extended.

An example of the tensioning system from VexU team BNS' robot for NBN

Continued to Page

SIGNATURE Cameron L

DATE 5/8/2016

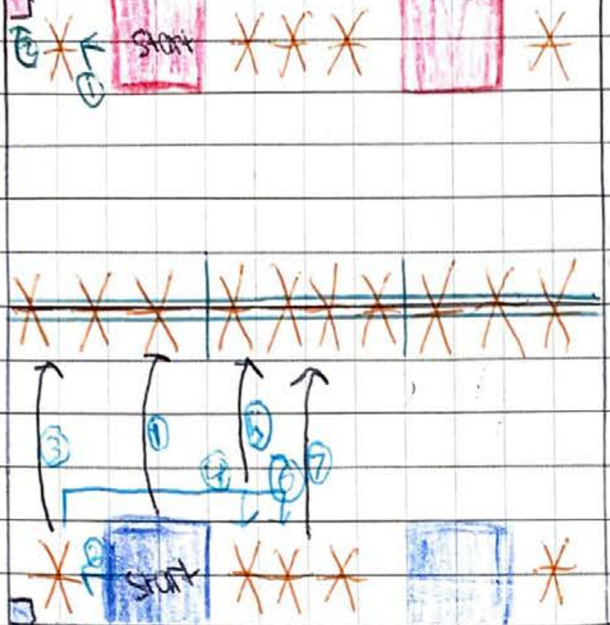
DISCLOSED TO AND UNDERSTOOD BY Michael Ryan

DATE 5/9/16

PROPRIETARY INFORMATION

TITLE Autonomous Strategy PROJECT

Continued from Page



Our Main Strategy for this year is to pick objects up off of the field then use them to knock objects off the fence. As a backup in case that strategy conflicts with our allies, we will result to hanging. As a worst case scenario, if that also conflicts, we will sit still and do nothing. The 4pts are very useful, so doing nothing would be the absolutely worst case scenario.

Pick up and Fire Strategy

For this strategy, we will first fire our preload. Then, we'll pivot turn and pick up the corner object, then fire it. Next, we'll move to the center field objects and pick up / fire them. This strategy is in theory great, but has some chances of failure. If an object is fired onto our side and we run into it, it would likely mess up our movement for the whole autonomous. It would likely score up to 16 pts (8 for zone), although that's under perfect circumstances.

Hang Strategy

For this strategy, we will pick up a corner object, then hang the pole. This strategy gives us 12pts for hanging, with a higher chance of success than the above, however it takes much longer to lower and unhook. It also gives us less of a head start in the game, because instead of scoring stars it hangs, which doesn't count as soon as we lower.

Continued to Page

SIGNATURE Cameron L DATE 5/9/2016

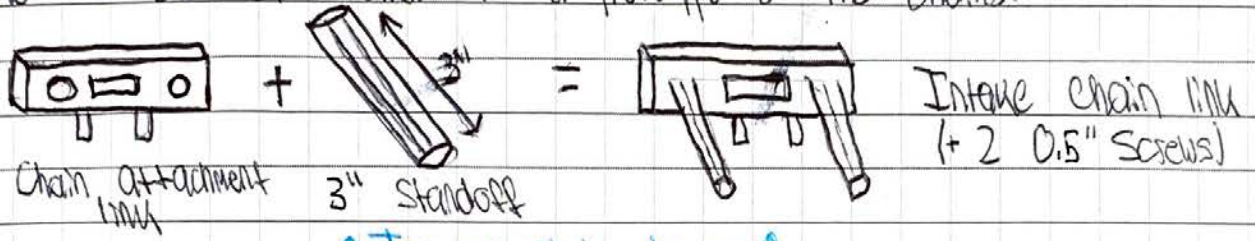
DISCLOSED TO AND UNDERSTOOD BY Michael Ryan DATE 5/9/16

PROPRIETARY INFORMATION

TITLE Build Log #1 PROJECT

Continued from Page

Today after intensive cleaning of the club and design/strategy meetings, the club has started building. We wanted to test the effectiveness of our chain intake design, so we quickly built the frame of our drive and built a prototype of the chains.



↑ Initial chain design ↑

With our initial tests, our feared issue occured. The intake chain links bent downwards and just slipped off of the stars! We decided to try to add cut pieces of the flat 5x25 aluminium pieces to grip the stars and keeping them from slipping.

Ground level — Fully lifted

This design worked very well and lifted using speed motors without straining them. The design worked just as we hoped, so we have decided to keep it for our final design. We need to shorten the cut 5x25 metal pieces to be about 5x3 to hold the stars without excess metal. We also realized that although the end pieces help hold the stars, they still droop excessively. Next meeting we hope to test adding more sprockets to the chain to help keep it tensioned. We also hope to use integrated encoders to the intake to keep them speed. We can't do this mechanically because the top prong of the star needs to pass between the 2 sides of the intake.

Continued to Page

SIGNATURE Cameron L

DATE 5/12/2016

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DATE 5/13/16

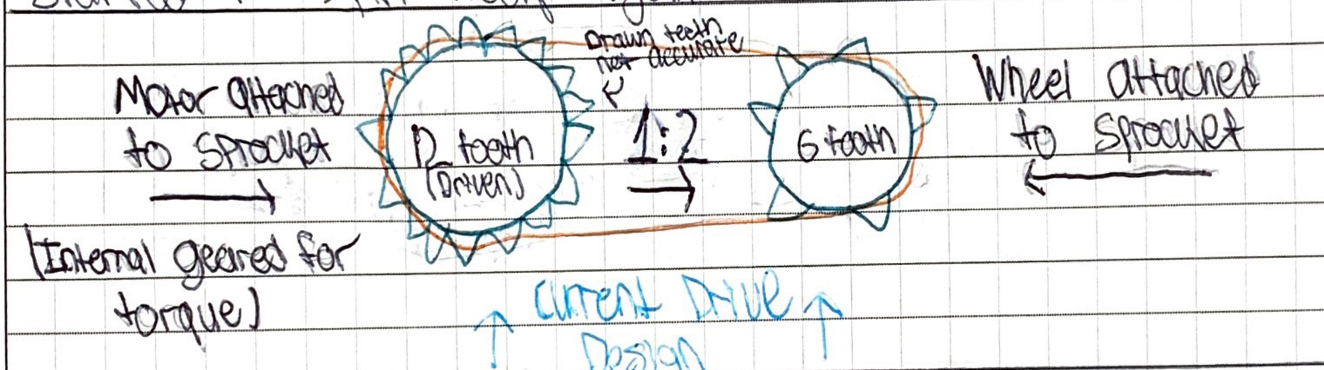
PROPRIETARY INFORMATION

TITLE Build Log #2 **PROJECT**

Continued from Page

Last Meeting on 5/17/16, we had a missing member and a few time delays, causing us to not get a lot done. We finished assembling one side of the drive, but we didn't get a chance to test it. We also disassembled some of our prototypes to make room for our more permanent design.

Today, we further continued working on the drive. We had an issue where the wheel wouldn't spin one direction, even when done by hand. For a long time we thought it was the chain getting caught on something. We couldn't see anything, so we decided to start disassembling it to get a better look. When we were pulling an axle out of the motor, we realized everything started to spin freely again.



We took apart the motor's internal gears, and found a small flake in the top gear section. After removing it, everything worked smoothly. We spent a large amount of time inspecting the chain, wasting a lot of time. We learned it's a good idea to quickly check every system involved with an ~~system~~ issue, instead of making assumptions. This should help us fix issues quicker and leave more time for building and improving.

Continued to Page

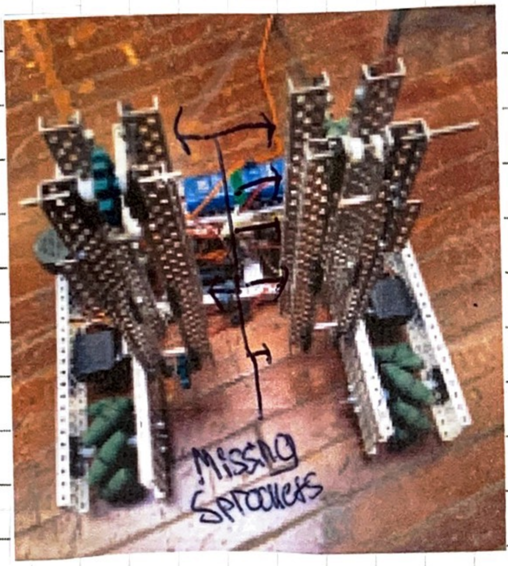
SIGNATURE Cameron L DATE 5/19/2016

DISCLOSED TO AND UNDERSTOOD BY [signature] DATE 5/24/16

TITLE Build Log #3 **PROJECT**

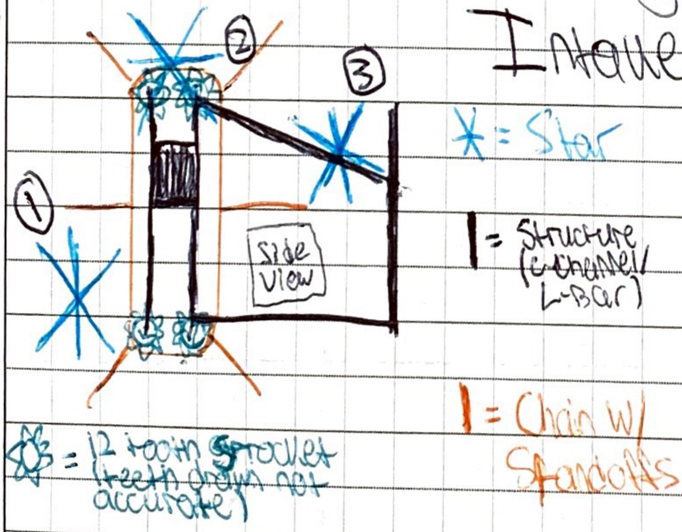
Continued from Page

Today after a lot of work, we got a lot done. We managed to finish building and install the intake "stacks" to the drive train, as well as building the right side of the drive.



Although we got all of this done, we sadly learned the club ran out of 12 tooth sprockets, and since we needed ~10 more to run the intake, we were unable to test it. Sadly we will have to wait about a week for more to come in, setting us really far back. Since we won't have them by next week's first meeting, we plan to refine our drive programming to help avoid possibly harmful maneuvers like driving fast forward then full strafing right.

Intake Design



We plan to pick stars up at position ① off the field. The 3" standoffs on the chain will go under 2 arms of a star. Once lifted to position ② they will be passively put onto the launching platform ③ by gravity. This setup will in theory let us hold multiple stars and launch them in quick succession. We're undecided on which launcher we're going to use at the moment. Since we have yet to test the intake, we aren't sure how fast or effective it'll be.

SIGNATURE Cameron L

Continued to Page

DATE 5/26/2016

DISCLOSED TO AND UNDERSTOOD BY Michael Ryan

DATE 5/31/16

TITLE Build Log #4 PROJECT

Continued from Page

Today we had another issue with the drive. Occasionally we would hear a loud clicking sound like gears slipping. We took apart each internal gearing for the drive motors to check for slipping, but we had no luck. We were completely stumped with what could be slipping, and asked an upper classman to help us out. He quickly realised that even though it was as tight as we could get it, the chain was too loose and was coming off the sprockets. He showed us how to tighten our chain by using spacers on a screw to lift and tension the chain.

Before | Chain is too tight to add another link, but loose enought to get pulled off the sprocket with sudden direction change

After | Spacer keeps chain nice and tight without being too tight, preventing unwanted slippage

We noticed that only the front wheels needed this spacer, and after recounting the distance from the motor to the wheel, the reason became clear. The wheels at the back were one whole further from the wheel, creating the tension the front wheels didn't have. Today we learned two very important lessons. One was to check hole distances even if you're positive they're right, and the other was it's okay to ask for help. It's very unlikely we would've solved the issue without the experience of the upperclassmen. Even if you can solve a problem, sometimes others will have a better solution.

Continued to Page

SIGNATURE Cameron L DATE 5/30/16

DISCLOSED TO AND UNDERSTOOD BY Michael Ryan DATE 8/9/16

PROPRIETARY INFORMATION

TITLE Build Log # 5 (S) PROJECT

Continued from Page

Today was our first meeting back since summer break. From now until the end of summer, we will be having meetings every 2 weeks. We have been working on getting our intake working, but have had an issue with the sprockets having a large amount of friction. Our first guess was that the axles were bent, but after further inspection, they were perfectly straight. Completely stumped, we asked a few upperclassmen for help, but they were just as stumped. Finally we asked our instructor, and he quickly saw the problem:

Before ↑

After ↑

The C-channels on either side were connected by standoffs, and were not perfectly aligned. Since screws aren't exactly the size of holes, there is some give in the position of the connection. To make correcting this easier, we replaced the standoffs with sideways C-channels screwed on with 2 screws on each side. This let us lay everything on a flat surface so it aligned correctly, and tighten it while it was still aligned.

Continued to Page

SIGNATURE Cameron L

DATE 6/28/2016

DISCLOSED TO AND UNDERSTOOD BY Michael Ryan

DATE 8/9/16

PROPRIETARY INFORMATION

TITLE Drive speed troubleshoot PROJECT

Continued from Page

Today I was working with the drive code and autonomous code to use encoder values. This will let us make consistent and reproducable movements without live user input. I noticed that the left side drive was moving slower than the right. The first thing I did was make a simple program where I could be sure I was setting the motors to the same speed, and got the same issue. Next, I changed the motor controllers on the left side to see if it would fix anything, but with no success. The next thing I did was change the left side drive to use the right side ports, and vice versa. The results I got were highly unexpected: both sides ran at the same speed. Stumped, I went back to the programming to check for mistakes. After a few minutes, I tested the drive again, but with crazy results. The left side drive motors would go forward for a second, then backward for a second and repeat. This amazed me, since I was setting the motors to go forward 50 and didn't change direction. Thinking something was corrupted, I went to reupload the code and got an error, "Battery extremely low (5.4v)! Results may be unpredictable" I finally realized that the battery hasn't been charged in a while, and after charging it, the issues went away. I assumed from the start it couldn't be the battery because only one side was underperforming. I now know that if I'm having any issues with performance to double check the battery is fine, and not just assume it's unrelated. I also hope to add a battery low warning to the LCD to give us a heads up so this doesn't happen again.

Continued to Page

SIGNATURE Cameron L

DATE 7/14/2016

DISCLOSED TO AND UNDERSTOOD BY Michael Ryan

DATE 8/19/16

PROPRIETARY INFORMATION

TITLE Build Log #6 (S) **PROJECT**

Continued from Page

Today, we finally finished our intake. It is a system of sprockets and chain, mounted to the front of the robot. It uses the grabbers defined on page 11, which work perfectly. We're using two torque motors, one on each side. The two sides of the intake are attached at the top of the ~~[illegible]~~ intake with a full length axle.

Now that our intake is done, it's time to start planning our launcher. Based on our findings earlier, we have decided that a slip gear catapult type launcher. Looking at videos from the first team's reveal, team 8059D. Although we won't be able to launch cubes, however we believe ~~the~~ launching and intaking stars at the speed we do will overpower the need to launch cubes.

Continued to Page

SIGNATURE Cameron L

DATE 7/12/2016

DISCLOSED TO AND UNDERSTOOD BY Michael Nguyen

DATE 8/9/16

PROPRIETARY INFORMATION

TITLE Launcher Powered by Intake **PROJECT**

Continued from Page

Now that our intake is properly working, I'm stuck thinking on where we can fit a launcher. Due to the large size of the game objects this year, the cradle to hold one on our robot takes up a lot of room. One idea from someone at our school was to have the cradle be the launcher as well, which would help with the space issue. On our current design, if the cradle was to be the launcher, the star would hit our intake. To fix this, the pivot point of the launcher would need to be at the top of our intake, which got me thinking... What if we used the intake Moters to power our launcher?

Reserved for Pictures

To get this to work, I know we'd have to change a lot about how our current intake is powered. At the moment, we are directly driving each intake stack with a single motor internally geared for torque. They are being programaticaly set to run at 60, which is about half speed. This alone would not be enough to power a strong enough launcher, but if we double the motors and run them at full speed it could work. The intake can be slowed down by gears to keep it at the same speed as now.

Continued to Page 19

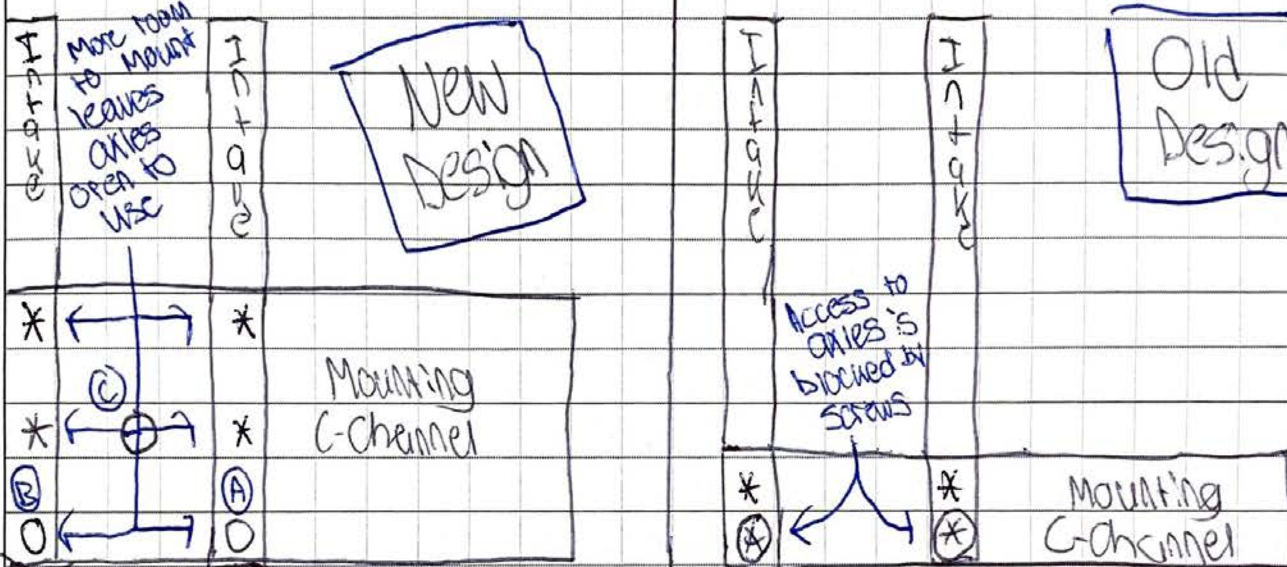
SIGNATURE Cameron L — DATE 7/18/2016

DISCLOSED TO AND UNDERSTOOD BY Michael Ryan — DATE 8/9/16

PROPRIETARY INFORMATION

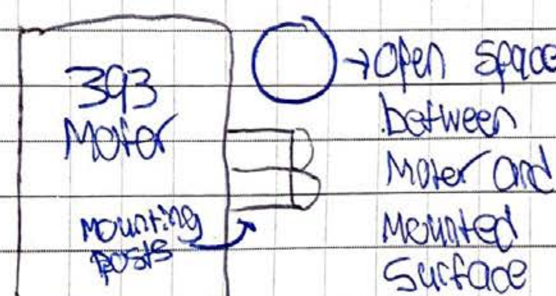
TITLE Launcher Powered by Intake **PROJECT**

Continued from Page 18 As you can see on Page 18, the intake is currently attached to a 2x35 C-Channel, which is attached to our drive. Since the path to the bottom sprocket's axel is blocked, the intake is driven from the top. The below diagram assumes the aforementioned 2x35 c-channel is replaced by a 5x35 c-channel, which we'll call the "Mounting c-Channel."



* = Mounting screw   1 square = 1 hole on a C-channel
O = Access to axle

The new mounting c-channel not only opens up the axles so we can drive the intake from the bottom, but gives us room to add gears that will later power the launcher. If you look at the "new design" diagram, both Ⓐ and Ⓑ axles would be driven by motors, directly driving the intake. Using the gap between the motor and the surface it's mounted to, we would put a 12 tooth gear. This would let us put a connecting gear at point Ⓒ, which would then go to our launcher.



Continued to Page 20

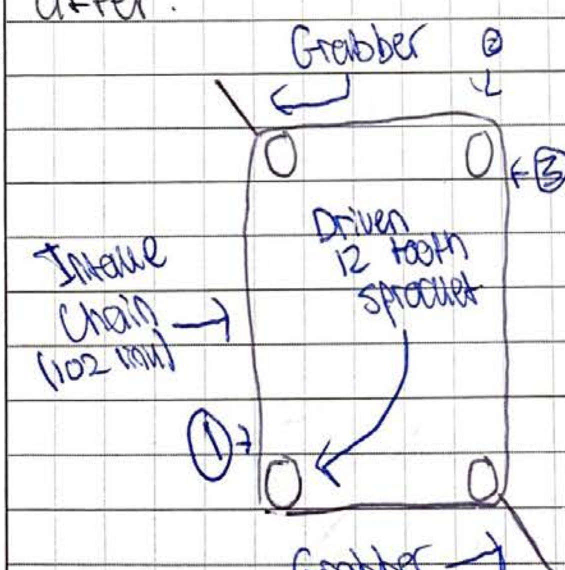
SIGNATURE Cameron L   DATE 7/18/2016

DISCLOSED TO AND UNDERSTOOD BY Michael Ryan   DATE 8/19/16

PROPRIETARY INFORMATION

TITLE More detail about launcher power PROJECT

Continued from Page 19 As described on Pages 18 and 19, we hope to connect our intake and launcher to run on the same 4 motors. This would let us save space as well as motors in our overall design. The goal of this entry is to help show why this would work with our design. Our intake uses two "grabbers" (described on page 17), one on either side of our intake. This means that when one grabber is at the top of the loop dropping a star into our launcher, the other is at the bottom about to pick up a star. Because of this symmetry, we can gear a slipgear launcher to launch twice every full rotation of the intake chain. On our current design, the intake chain has 102 links, with the grabbers on the 51st multiples. Driven by 12 tooth sprockets, we know that every 8.5 rotations of the motor we cycle the whole loop, meaning our launcher needs to pull back and launch every 4.25 rotations of the driven gear. By using a later determined gear ratio, we'd be able to sync the launcher in a way that it's primed when a star drops off the intake, and have it launch soon after.



1. Launcher starts pulling back when a grabber reaches this position
2. Intake drops star on almost primed launcher
3. Launcher fires
4. Cycle repeats at 1 with the other grabber

Continued to Page

SIGNATURE Cameron L DATE 7/18/2016

DISCLOSED TO AND UNDERSTOOD BY Malace Ryan DATE 8/9/16

PROPRIETARY INFORMATION

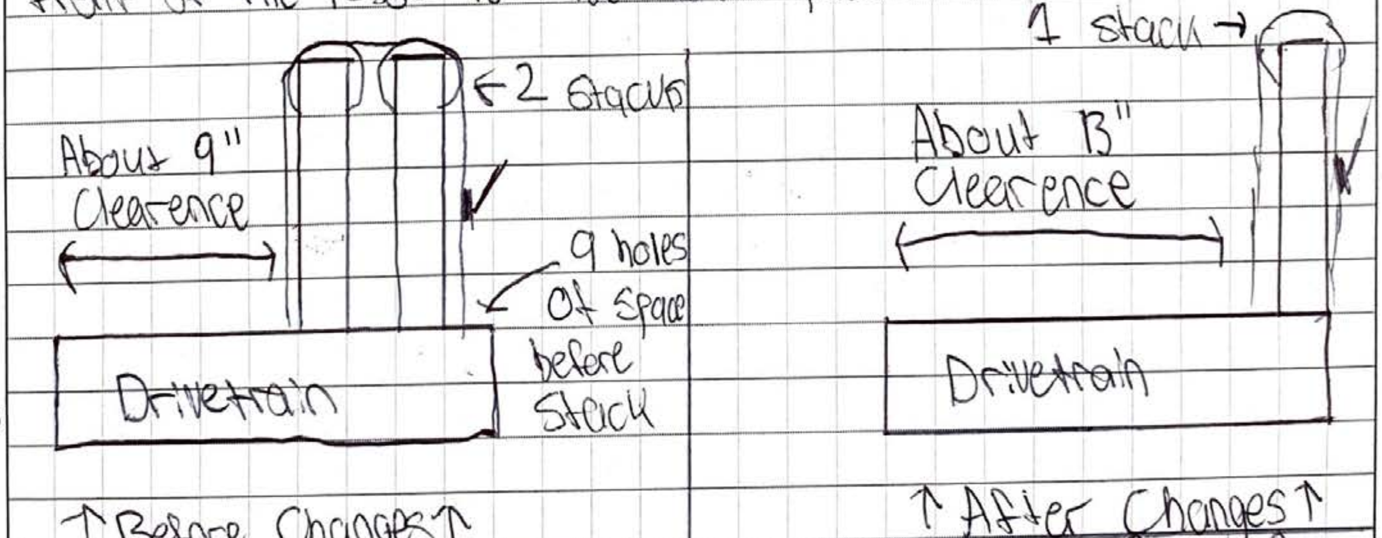
TITLE Design Changes to Intake PROJECT

Continued from Page

Today was supposed to be our next Summer Meeting, however it was pushed back a week. Instead, my group discussed our current design, and decided to change it. We noticed that the design of the intake and launcher combined had a few issues:

1) If either the launcher or intake got jammed, the other would be disabled aswell
2) It would put a lot of stress on the running Motors
3) It would be difficult or impossible to get a gear ratio working at exactly the ratio we would need.

Because of this, we have decided to go with the original plan of seperating the intake and the launcher. We also decided to cut the second intake stack. It gave no benifit, and if anything, it decreased efficiency. Cutting it also gives more room for us to build the star launcher. We also moved the intake closer to the front of the robot to save more space.



Continued to Page

SIGNATURE Cameron L

DATE 7/26/2016

DISCLOSED TO AND UNDERSTOOD BY Michael Ryan

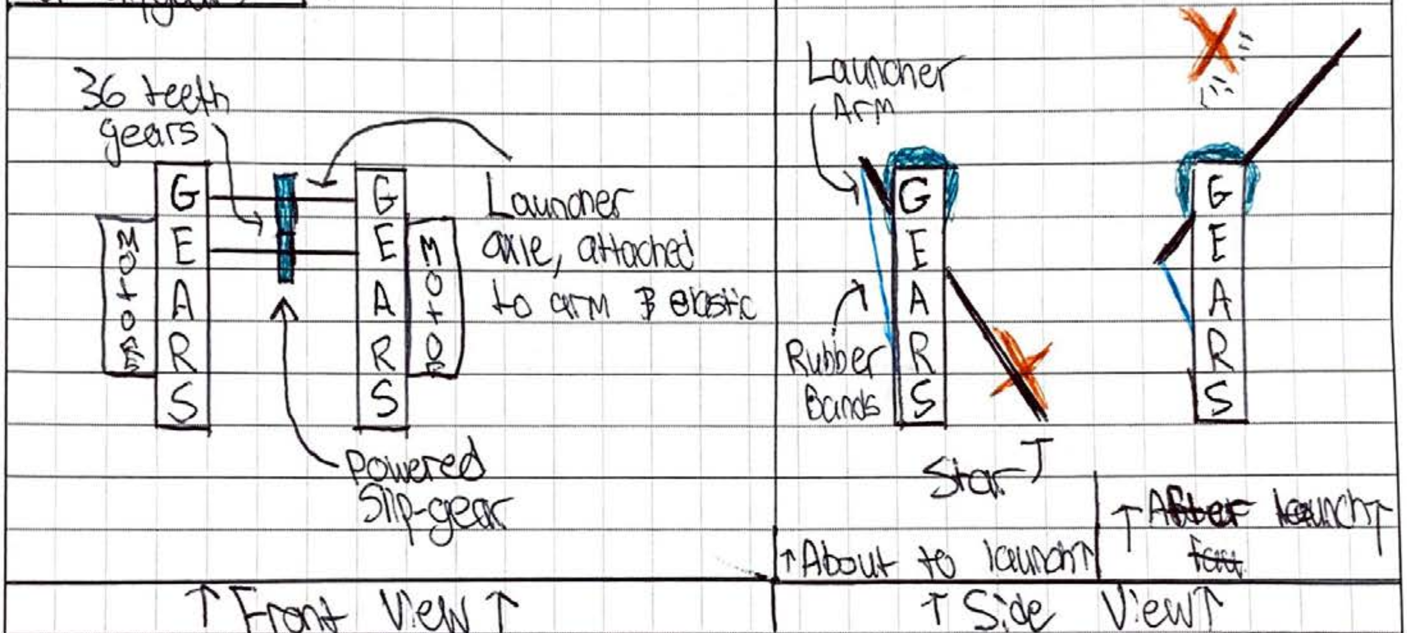
DATE 8/9/16

PROPRIETARY INFORMATION

TITLE Launcher design **PROJECT**

Continued from Page

As stated on page 17, we are using a catapult designed after team 8059D's. It's a catapult powered by a slipgear.



Our launcher will have a spatula-type arm attached to the launcher axle. It will have rubber bands pulling down opposite of the star side, creating the force we need to launch into the far zone. We hope to be able to only use 2 torque motors, but if it's too slow, we will have to add 2 more. We have decided to go with #64 rubber bands, and ordered reliable bands with high rubber content to allow for them to be mounted far from the launcher, down by our drive. This will ensure that we don't need to build another structure just to hold bands.

Continued to Page

SIGNATURE Cameron L DATE 7/29/2016

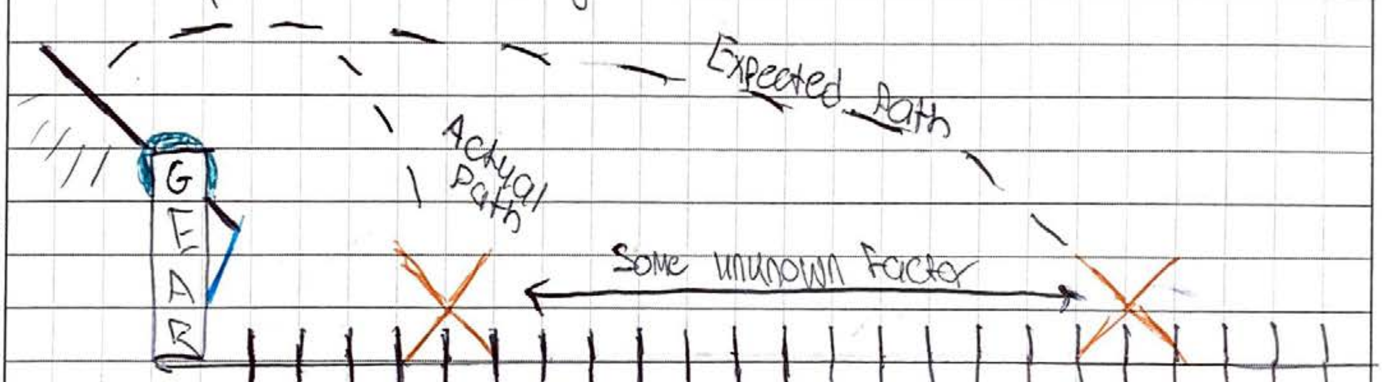
DISCLOSED TO AND UNDERSTOOD BY Michael Nyan DATE 8/9/16

PROPRIETARY INFORMATION

TITLE Build Log #7 (S) **PROJECT**

Continued from Page

Today we started work on our launcher, described on page 22. The design fits perfectly after the changes to the intake, however we seem to be lacking the force needed to launch anything very far. Even with excessive amounts of elastics which, according to our reference video, should launch a star miles, we barely get a foot. We tried positioning the rubber bands differently and even launching objects. When dry fired, there seems to be enough force, but when there's any weight, all the strength disappears. I don't think it's friction, because the bar slides smoothly, even under weight.



Hopefully, we will be able to find the issue in our launcher soon, so we can have a working design by the end of the summer. I'm guessing it's someting we're missing from 8059's design, because from all we can tell, our design should be working perfectly. Next meeting, which this time is only a week away, we will continue to use trial/error to find the cause of error.

Continued to Page

SIGNATURE Cameron L

DATE 8/2/2016

DISCLOSED TO AND UNDERSTOOD BY Michael [illegible]

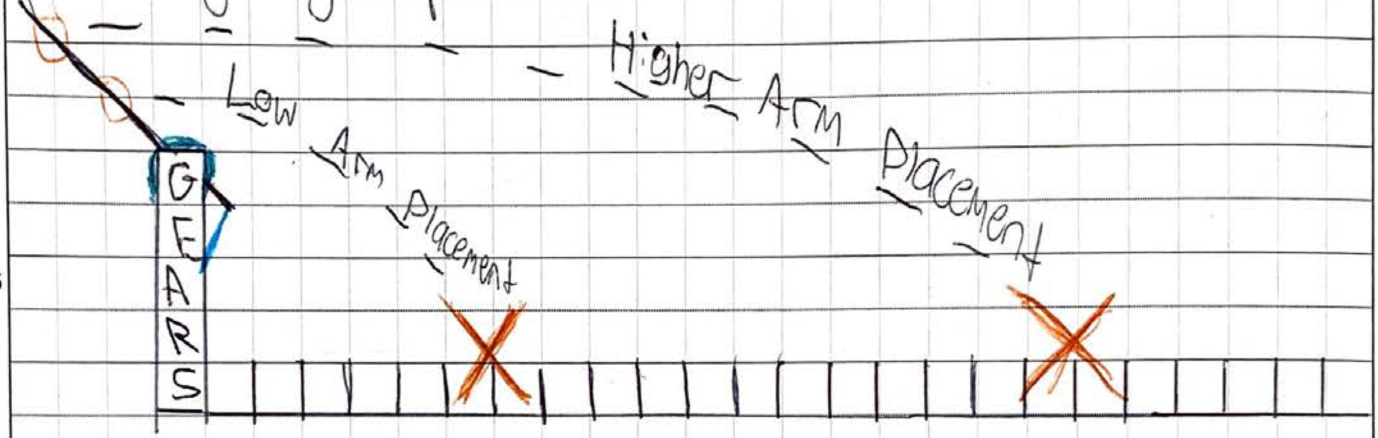
DATE 8/9/16

PROPRIETARY INFORMATION

TITLE Build Log #8 (5) **PROJECT**

Continued from Page

At today's meeting, we started working on motorizing the launcher, and getting the launcher to launch further. After a large amount of trial and error, we learned the star goes further when it's closer to the end of the launcher arm. With this fix, we can now launch over the fence from the edge of the field. We're starting to test the launcher with a 5:1 gear ratio and 2 motors, however it's not looking promising. The motors seem to be under a lot of stress, and the robot light goes yellow.



Since the next meeting is the last of the summer, our group plans to meet a few times before to finish our bot. Over the next two weeks, we hope to successfully motorize our launcher, and make our intake much faster to create a very competitive robot.

Continued to Page

SIGNATURE Cameron L DATE 8/19/16

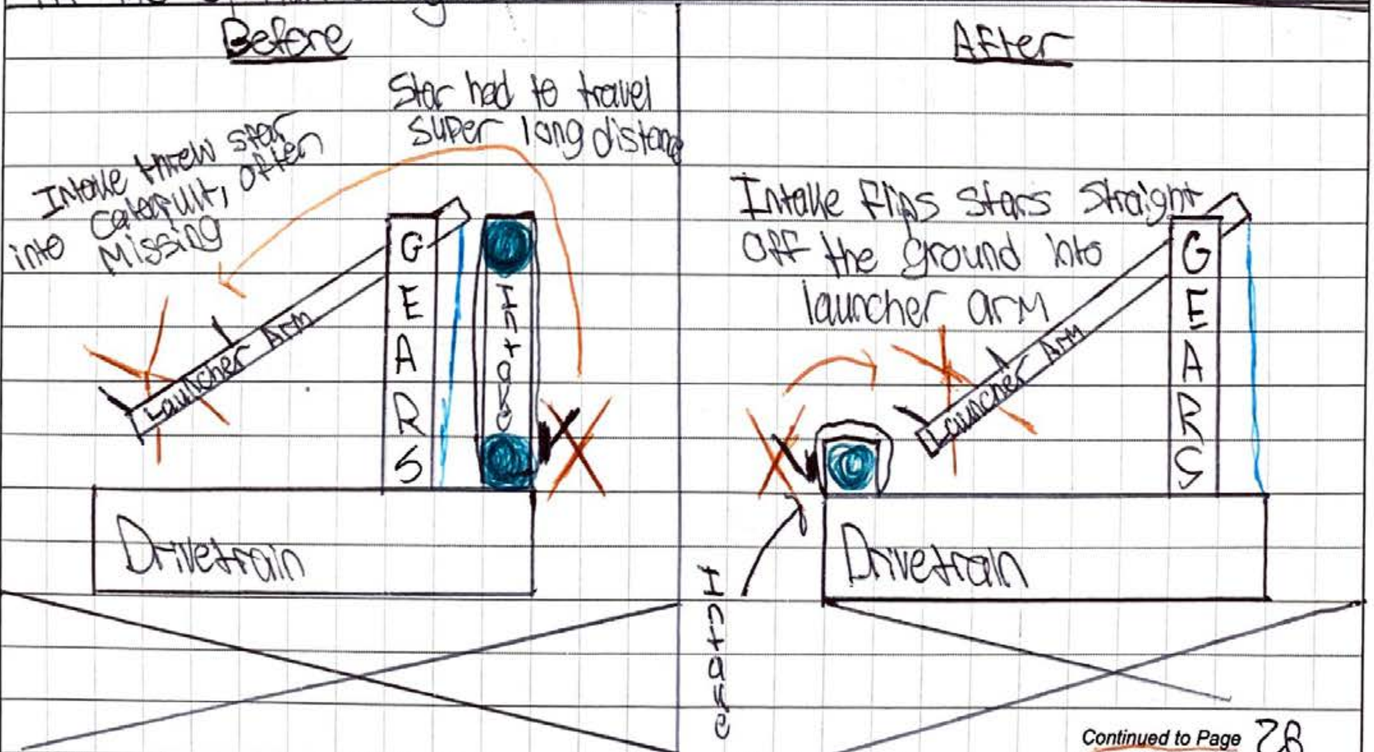
DISCLOSED TO AND UNDERSTOOD BY Michael Ryan DATE 8/23/16

TITLE Robot Design #2 PROJECT

Continued from Page

After attaching 2 more motors to our launcher, now totaling 4 torque motors, the launcher is working flawlessly. The 5:1 ratio works perfectly, pulling 8 #64 rubber bands. Currently, we have a length of pneumatic tubing attached to the launcher arm and the drivetrain, which is currently acting as the stopper for our slipgear. We are able to perfectly launch stars 26" high from over 6ft away, easily clearing the wall.

At our last meeting, our club's instructor, Mr. Dilks, was talking about the best/fastest ways of scoring. One method he mentioned was a robot that could pick up stars quickly and immediately launch them. Although we can shoot pretty fast, our intake was slow and had to carry the stars a long distance before they reached our launcher. Also, since the stars are dumped from the pivot point of the launcher, they miss the catapult claw frequently. Because of this, we thought about how we could change our design to better fit the optimum design.



Continued to Page 28

SIGNATURE Cameron L

DATE 8/13/2016

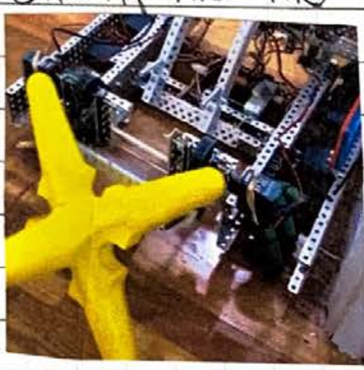
DISCLOSED TO AND UNDERSTOOD BY Michael Ryan

DATE 8/23/16

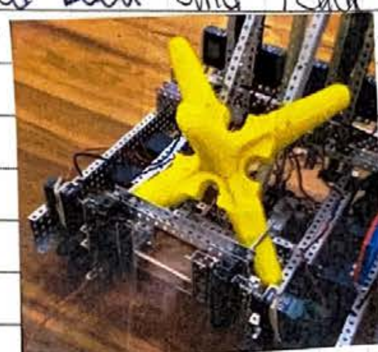
PROPRIETARY INFORMATION

TITLE Robot Design #2 **PROJECT**

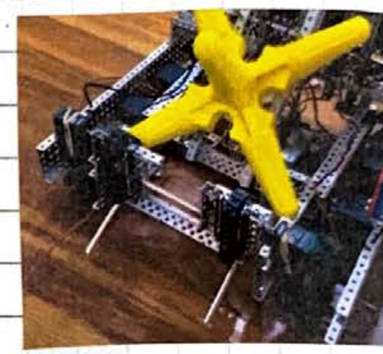
Continued from Page 25 On our old design, the intake carried the star from the ground to 18", then dumped it from the front of our robot to the back, and then the launcher fired the star back towards the intake. This was extremely inefficient. We thought of how we could still use our very successful grabbing technique, but find a way to speed up the process, with a higher success rate. The decision was to massively shorten the intake, from ~16" to about 3", essentially eliminating the useless carrying time. Then, we'd swap the placement of the intake and launcher so the star would go directly into the pulled-back and ready to shoot launcher.



Intake grabs star off the ground with Prongs

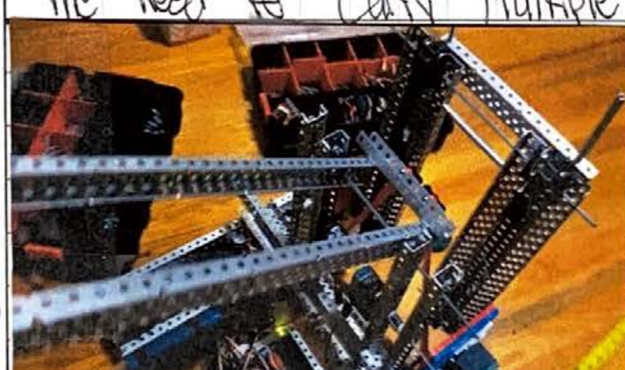


Intake lifts star into the catapult claw



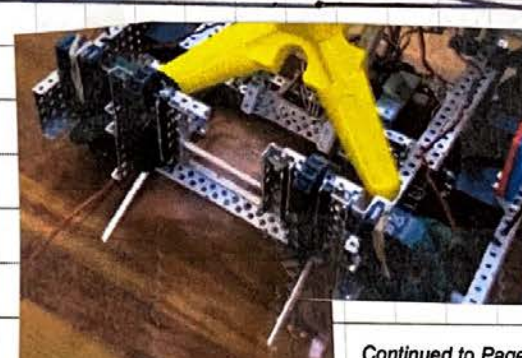
Intake retracts, making robot ready to shoot

This was a major change to our robot, and although we can no longer carry multiple stars, we should be able to pick them up and shoot them at a much faster pace, negating the need to carry multiple stars.



Before

After



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SIGNATURE Cameron L

DATE 8/13/2016

DISCLOSED TO AND UNDERSTOOD BY Michael [illegible]

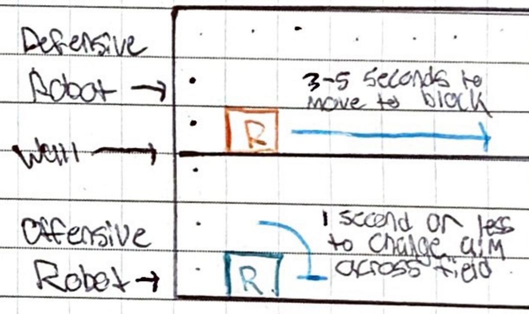
DATE 8/23/16

PROPRIETARY INFORMATION

TITLE Launcher Vs. Lift PROJECT

Continued from Page

With most (well, actually, all) other teams we've seen so far using lift-type robots, I thought I would go over the pros and cons of each type, and why we've stuck with a launcher type robot despite the challenges.



Defense / Blocking

Lift type robots typically have the ability to block other robots with their lift. Against other lifting robots, this can be very effective, because they can move along the wall at the same pace as the offensive bot, maintaining the block. A launcher robot, however, can simply point turn, changing their aim much faster than the defensive bot could possibly move. The downside of the launcher bot is that without a secondary system, it cannot block.

Offense / Scoring

Lift type robots typically use some sort of scoop to pick up stars and dump them over the wall. One downside of this is that it can only score while close to the wall. Launchers, on the other hand, can launch from anywhere on the field when built right. At the current stage, we can only launch one star and no cubes.

Conclusion

We find that although we can't move cubes and can only score one star at a time, we can still score stars at a fast pace and are able to avoid defenders. We think the speed advantages outweigh the reliability and denfensive capabilities of lifts, which is why we have stuck with working on our launcher type bot.

SIGNATURE Cameron L

Continued to Page

DATE 8/15/2016

DISCLOSED TO AND UNDERSTOOD BY Mr. [illegible] [illegible]

DATE 8/23/16

PROPRIETARY INFORMATION

TITLE Programming Workflow **PROJECT**

Continued from Page

With both Michael and I working on the robot's program, and currently 1,403 lines (including comments) of code, programming is a big deal for us. With our complex LCD code, multiple autons, PID drive, and much more, it's a lot to manage. So how do we do it? First, we use git versioning (www.github.com/EastRobotics/2616E) to easily merge code made between our multiple programmers. This makes it easy to easily grab different versions of our code, and manage the frequent changes we make. Next, we split our code into multiple files to make reading and finding methods easier. Currently, our code is broken down into the following files:

- main.c: Competition template, and the center of all code. Starts needed tasks, including background LCD updating and auton selector. Also handles user input for driving.
- lcd.c: Handles everything for the LCD, including hold time detection, refreshing, and paging.
- auton.c: Holds all of our individually programmed autons, and the backend of the auton selector (front end in lcd.c)
- drive.c: Handles all of our drive, including thresholds, motor curve correction, holonomic control, PID, and more.
- sensors.c: Has methods to make interacting with sensors easier, like gyro simplification and voltage regulation. Also has all of our complex math methods.

The multiple files makes our 1400 lines much more manageable. Another way we improve readability is by commenting each method with a general description, parameters description, returns description, and also any other notes about the method. With originally being Java programmers, we stole this idea from the beloved JavaDocs system. Finally, since our code frequently changes, we keep a "beta" and "release" folder to ensure we always have a working and tested version on hand. This will help make sure we don't load broken code onto our robot once competitions start.

Continued to Page

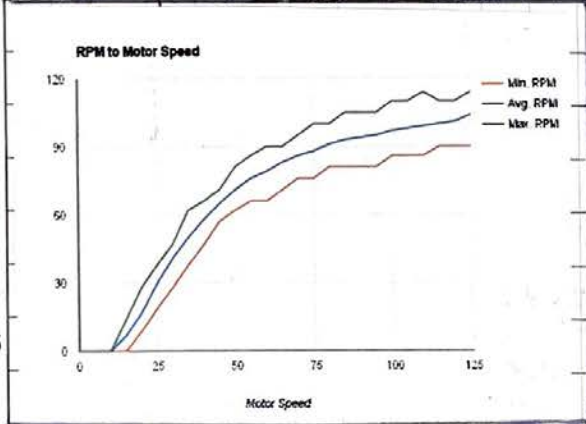
SIGNATURE Cameron L   DATE 8/18/2016

DISCLOSED TO AND UNDERSTOOD BY Michael Ryan   DATE 8/23/16

TITLE Straightening Log. Motor Curve PROJECT

Continued from Page

Cameron and I decided to run a test of the motors and how fast they spin at different speeds in order to help with our PID code. To accomplish this task, we wrote some software that read the RPM 200 times over 5 seconds, in order to find the maximum, minimum, and average RPM for each speed. We wanted to run these tests, so that we would be able to make a function allowing us to convert between motor speed and RPM.



This function would enable us to match the RPMS of the various motors in the PID loop. I noticed the shape of the graph closely related to a standard logarithmic graph. To find the equation of the graph I used logarsthmic regression in microsoft excel. It gave me this equation that closely related to our data points: 44.486ln(x)-105.47 Now all I had to do was find the inverse function so I could convert them both. I started with the equation excel gave me.

$$f(x) = 44.486\ln(x) - 105.47$$

$$x = 44.486\ln(y) - 105.47$$

$$x + 105.47 = 44.486\ln(y)$$

$$\frac{(x+105.47)}{44.486} = \ln(y)$$

$$\boxed{e^{\frac{(x+105.47)}{44.486}} = y}$$

Now that I had these equations, we would have the ability to swap between motor speed and RPM. I translated the math into two simple functions in robot C. Having accomplished my task, I thought my work was done however Cameron had an incredible idea. He noticed the logarithmic shape of the motor speed and RPM relations. This would result Continued to Page 30

SIGNATURE Michael Ryan

DATE 8/23/16

DISCLOSED TO AND UNDERSTOOD BY Cameron L

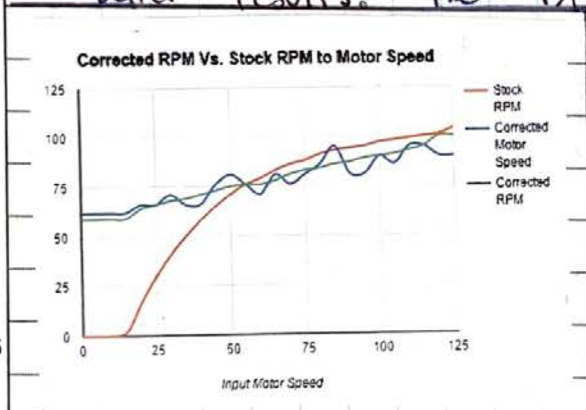
DATE 8/23/16

PROPRIETARY INFORMATION

TITLE Straightening Log. Motor Curve **PROJECT**

Continued from Page 29

in confusing motor RPMs for a given joystick motion. For example, moving the joystick half of the possible range would result in the motors going at nearly full speed, while moving the joystick a quarter of the possible range might result in the RPM being about a fifth of it's potential. This behavior is not ideal for the driver of the robot who would be expecting a direct relationship of motor speed to RPM. I knew there was a great solution to this problem by using linear interpolation. My idea was to essentially make a linear function relating the maximum RPM & joystick values, with the minimum RPM & joystick values, and use that equation to find everything in between. I made the minimum bounds variables so we could adjust our thresholds, then all I had to do was find the slope and y-intercepts of the equation. It finds the desired RPM, and uses my RPMToMotor function to get a motor speed. After running a few tests we seem to be having considerably better results. The RPM seems to have very linear growth while the motor speed fluctuates around it. These RPM and motor Speed conversion functions seem to have many applications, not just for PID as they were originally intended.



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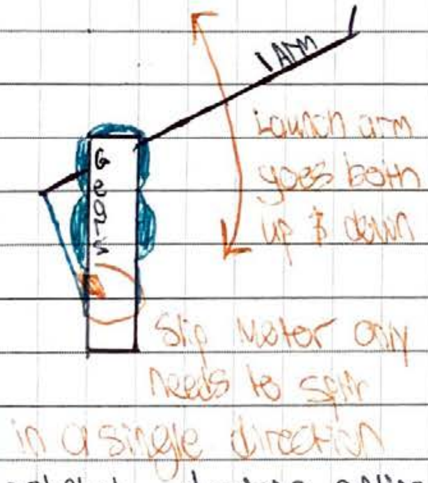
SIGNATURE Michael Nyan DATE 8/23/16

DISCLOSED TO AND UNDERSTOOD BY Cameron L DATE 8/23/16

TITLE Build Log #9 (S) PROJECT

Continued from Page

Today's meeting was the last of the summer. Leaving our robot at school, it will likely be a few weeks until work resumes. After working on improving the speed, stability, and reliability of our launcher by increasing mounting points, adding spacers, and adding collars, we started to brainstorm on how to fix a problem we've been having. Although our intake perfectly places a star into the catapult arm, we have trouble keeping the arm still long enough to intake. The 8 bands on the arm return it to starting position when the motors rest. We thought of a few different ways to fix this issue, but many limited other aspects of the robot. One idea was to use a pneumatic lock like we did early in NBN. This would work, however we'd be limited to 10 motors, and also have a limited number of shots. Another idea was to increase the torque via the arm gear ratio so it could hold the arm, but this would significantly decrease our shooting speed. Finally, we realized something:



The arm backdrives by pushing upwards, spinning the slipgear backwards. Although our arm is bi-directional, the slipgear only needs to turn 1 way. Because of this, if we add a ratchet mechanism into our gear assembly, we can stop the arm from backdriving with no effect on our launching capabilities. This is the clear choice, because with NBN just finishing, there is no shortage of Vex ratchet designs online, so by next meeting we should have a design that should suit our needs.

Continued to Page

SIGNATURE Cameron L

DATE 8/23/16

DISCLOSED TO AND UNDERSTOOD BY [illegible]

DATE 9/20/16

PROPRIETARY INFORMATION

TITLE Build Log #10 **PROJECT**

Continued from Page

With today being the first meeting of the school year, not much building was done. Instead, we had a long meeting to welcome the new members and introduce them to the club. We talked about this year's game, and spent time talking about strategy and different robot types.

After a long summer of sticking with our launcher robot, today was the first day we could really show off our launcher bot. At the beginning of the year, all East teams but us were using ~~tall~~ lifting bots, quickly dismissing lifts due to their complexity. After seeing the success of our current bot, I know of at least 2 East teams that plan on using a design similar to ours. This success makes the hard work of getting this design working worth it, because now it's helping other East teams get ahead of the game, and giving them a successful model for their own launchers.

With a little over a month til the first competition, our team has a very good chance of being 100% ready at the first competition. We'll need to stay focused however, because with two meetings a week, a month goes by fast.

Continued to Page

SIGNATURE Cameron L

DATE 9/13/16

DISCLOSED TO AND UNDERSTOOD BY [signature]

DATE 9/20/16

PROPRIETARY INFORMATION

TITLE Build Log #11 PROJECT

Continued from Page

Today we picked up where we left ~~off~~ off at Meeting #9. We planned to use a ratchet from NBN, but most we found wouldn't work well in our robot. Most were built off of 84-tooth gears, and didn't look like they could hold much force. I saw one that jamed a pillow block into two pinions. After playing around with pillow blocks to see how they could fit into our design, I figured out another way to go about making a rachet, ~~usign~~ using the gears we already have in our launcher. Using the time we had today, we built a prototype:

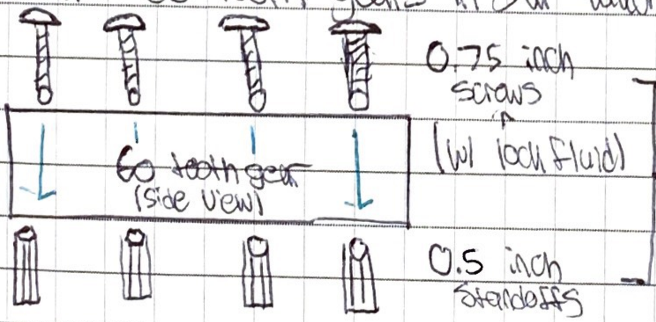
- Pictures — — — Pictures — — ~ Pictures -

The ratchet works on the idea that when you have a pillow block loose on an axle, and have something solid inline with it, you can prevent it from pivoting further:

Solid object, like a standoff, keeps ~~at~~ bearing from pivoting all the way

Bearing can pivot further to the other direction, allowing things to pass in that direction only

We used this concept, and worked out how we could add this to our 60 tooth gears in our launcher. Here's what we came up with:

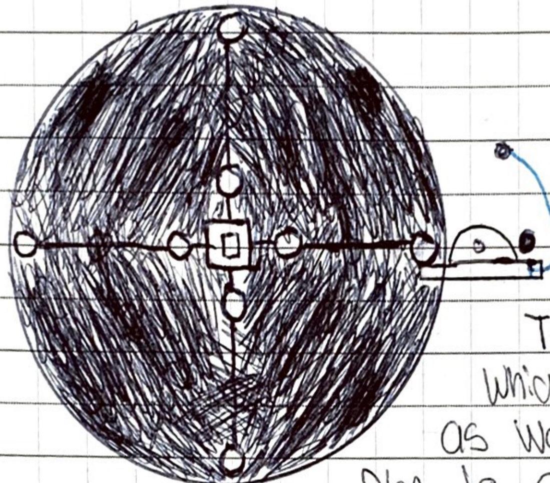


Continued to Page 34

TITLE Build Log #11 **PROJECT**

Continued from Page 33 With a mix of the gear and bearing systems described on page 33, we were able to achieve a very strong ratchet like so:

Note: 4 Missing holes in the below drawing



Elastics re-close the lock after it's been pushed open

This setup allows for 8-clicks a rotation, which should be plenty for our launcher arm, as we dont need super accurate positions. We plan to extend the outer bars on the Motor structure to make room for the rachets next meeting. When this is done, design #2 should be in a competition ready state, allowing us to tweak and improve until comps start late October.

Continued to Page

SIGNATURE Cameron L

DATE 9/15/2016

DISCLOSED TO AND UNDERSTOOD BY [signature]

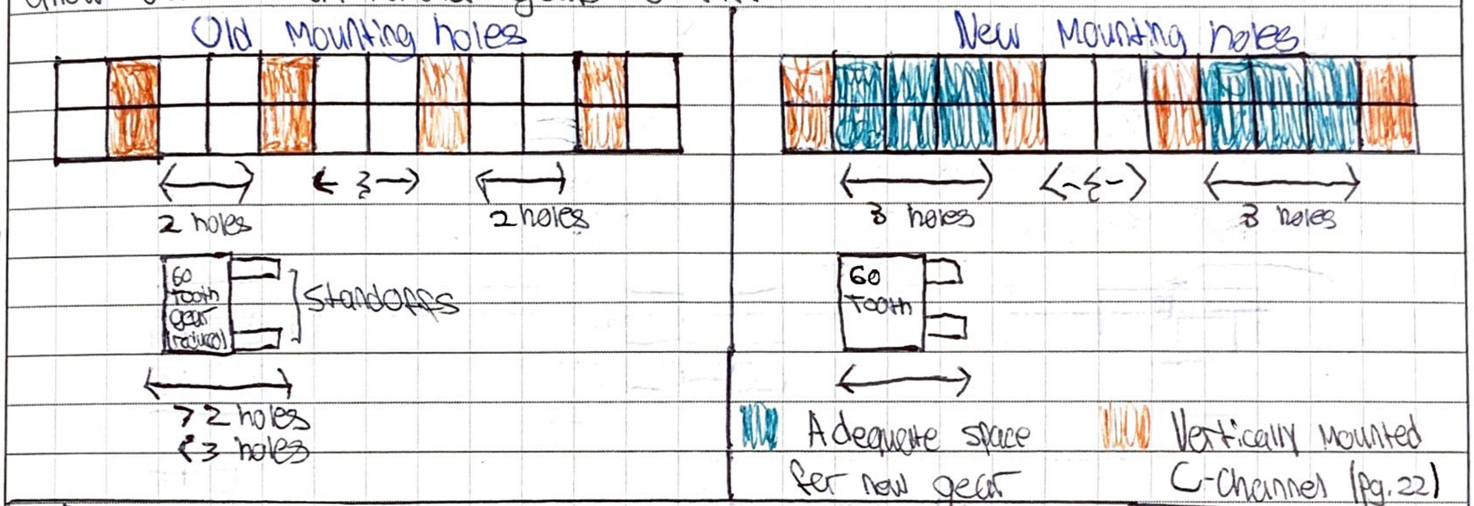
DATE 9/20/16

PROPRIETARY INFORMATION

TITLE Build Log #12 PROJECT

Continued from Page

Todays meeting started with a 15 minute talk about some upcoming events and procedures, slightly reducing the build time for today. After prototyping the rachet gear last meeting, we started building the assemblys to house the ratchet parts, as well as widening our launcher gear rack to allow our custom ratchet gears to fit.



Although we only moved 2 bars one hole over, this takes a lot of time when dealing with our launcher. Each bar had 5 locknutted screws, all in awkward positions. Because unscrewing and rescrewing took so long, we barely had time left in the meeting to built the ratchet mechanism housings.

Luckily, we had them predesigned in CAD, so we were able to quickly throw them together before the meeting concluded. Next meeting we hope to finish the ratchet, and if it works as planned, we should have a fully functioning robot ~~that~~ we can start to tweak and improve for our first competition October 22nd.

Continued to Page

SIGNATURE Cameron L

DATE 9/20/16

DISCLOSED TO AND UNDERSTOOD BY Michael Ryan

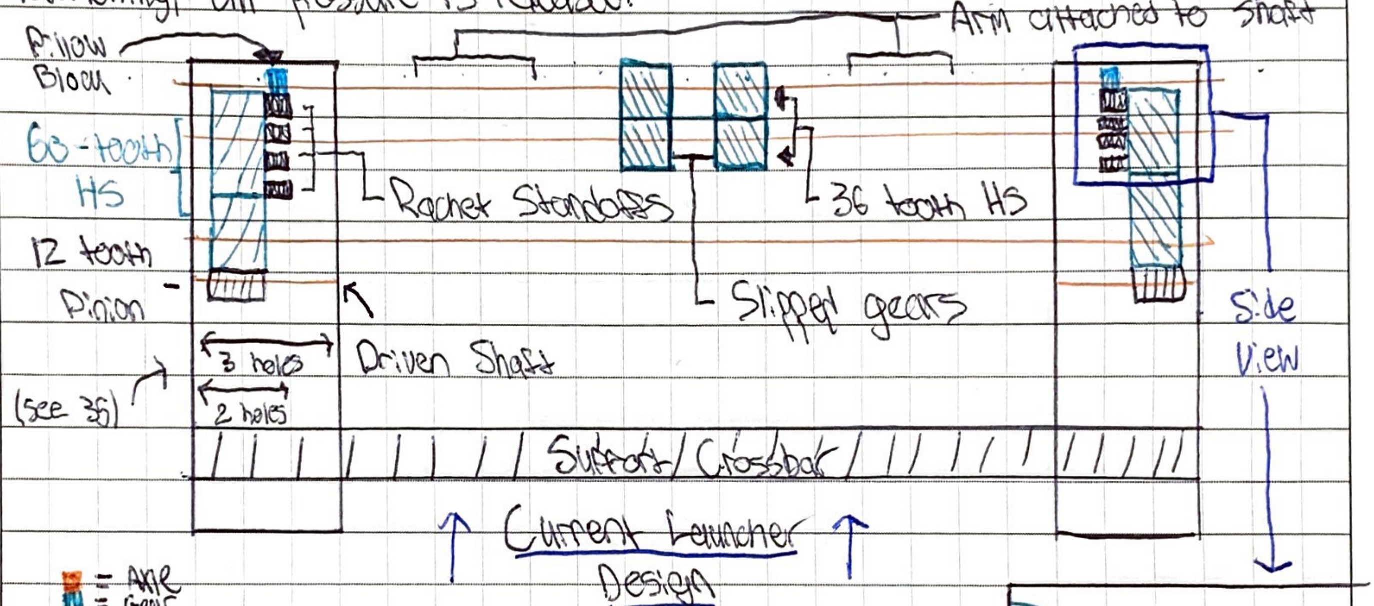
DATE 9/22/16

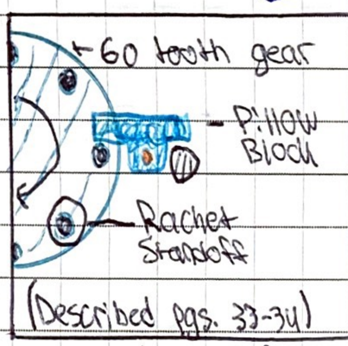
PROPRIETARY INFORMATION

TITLE Build Log #13 **PROJECT**

Continued from Page

Today's Meeting Consisted of a lot of busy work involving the rachet system. Last Meeting we built assemblies intended to house the clicking/locking Mechanism of the rachet, however the holes didn't line up as well as they did in CAD, so we slightly changed the design. Instead of having our lower 60-tooth gear be the ratchet gear, we used the upper gear. Then, the pillow block was mounted on the pre-existing arm axle. This shouldn't affect the arm's performance, because the only time any pressure is on the bearing is when the arm is idle or cocked back. When it's launching, all pressure is released.





Today we managed to build the assembery above, however we need two new axles to fit the motors now that the gap is bigger. Hopefully next build Meeting we can finish and test the launcher. We need to be at a working state by Oct. 5th for a presentation, which we believe can be done. It might be a few days until our next build Meeting, as we have plans to do room cleanup / organization.

Continued to Page

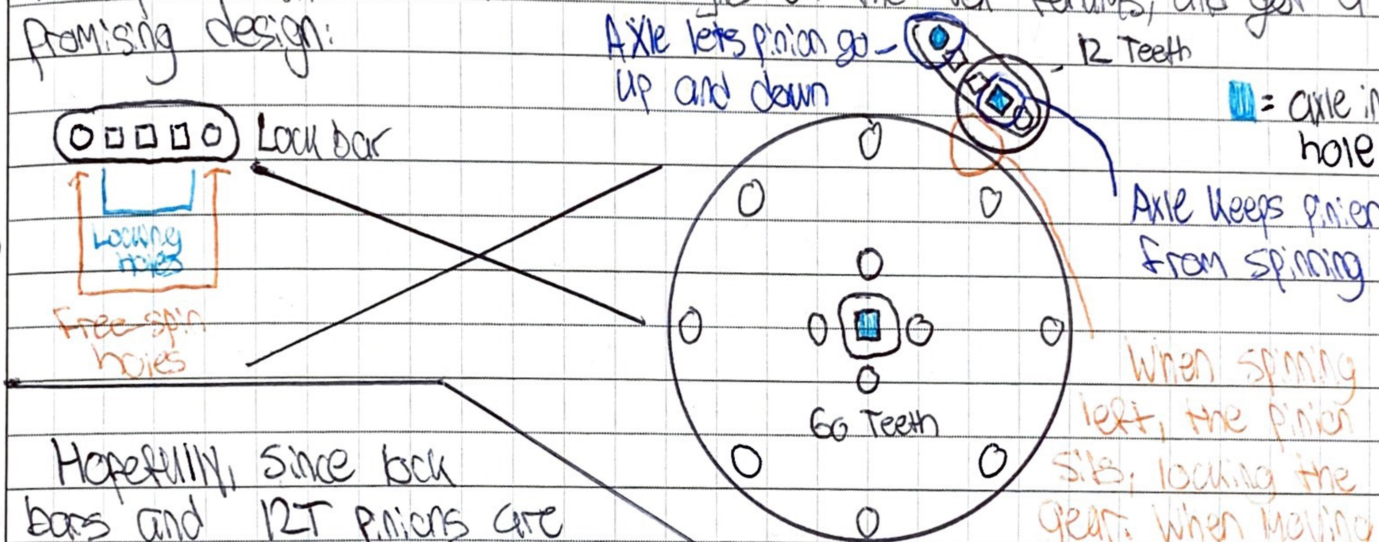
SIGNATURE Cameron L DATE 9/22/2016

DISCLOSED TO AND UNDERSTOOD BY [signature] DATE 9/29/16

PROPRIETARY INFORMATION

Continued from Page

Today we finished and tested the ratchet with poor success. First, the ratchet had very low resolution, so we couldn't get the arm to lock in the right spot. Then, when we put full load on it, the arm had enough force to severly bend the pillow block, letting it slip. Stuck, we asked for designs on the Vex Forums, and got a promising design:



Hopefully, since lock bars and 12T pinions are both metal, this should hold up very well. Before we add it, we need to undo the widening described on page 35, which should give the gears a lot more strength, and a lot less flex. Since we have a presentation October 5th, we have the robot home for the weekend. This should give us plenty of time to add the new ratchet, and if it works, we can finally start perfecting the intake.

Continued to Page

SIGNATURE Cameron L DATE 9/29/2016

DISCLOSED TO AND UNDERSTOOD BY [signature] DATE 10/5/16

PROPRIETARY INFORMATION

TITLE CHPS Presentation PROJECT

Continued from Page

Today, we presented a few of the clubs robots at a CHPS Meeting. Although there weren't any scrimmages, it was our first prolonged time on the game field, and we learned a few things:

1) Our catapult works as designed, and can hit other stars off the wall with other stars, however sometimes both stars fall backwards onto our side of the field.

2) The typical metal shaft collars holding our gears in place will not hold very long, and need to be replaced with the larger black collars that have locknuts and 32 screws in them. The collars came loose without us realising, and when the gears misaligned, we cracked 3 out of the 4 36 tooth gears on our launcher, 2 of them being our slipped gears, which we now need to recut

3) The simple ratchet described on page 37 works great. We had to temporarily scrap a motor off of our intake to replace a broken one on our drive, but when we fix it, we should be able to properly intake from the field.

With the next (really the first) competition in just under 3 weeks, we are feeling the pressure to finish our robot. Luckily, if everything works out, we should be ready in one to two meetings, leaving us time to practice driving, program auton, and develop strategies to counter dumpers. Tomorrow is our next meeting, and we hope to fix the intake and launcher, possibly finishing our current design.

Continued to Page

SIGNATURE Cameron L | DATE 10/5/2016

DISCLOSED TO AND UNDERSTOOD BY Michael Nyan | DATE 10/11/16

PROPRIETARY INFORMATION

TITLE Build Log #15 PROJECT

Continued from Page

Today we didn't get much done, but the work we did will prepare us for the meetings next week. In sight of the upcoming tournament the meetings for next week have been extended ~~by~~ an hour, which should give us plenty of time to finish up our design.

Today we went through the lengthy process of cutting new slip gears. This took a large portion of the meeting, because we were being very careful to cut them neatly. If you accidently cut all the way through the plastic instead of shaving the teeth, it can weaken the gear, causing it to collapse in on itself.

The next meetings until the first competition on ~~10~~/22/16 are extended by 1hr, which should give us time to get a lot done. In the next few weeks until the competition, we plan to do the following:

1) Finish tweaking the launcher
2) Program arm to pull back down automatically
3) Program intake to go back down automatically
4) Compete among the team to pick a driver
5) Practice against other east teams
6) Program autonomous

And after the first competition, we hope to add features to speed up launching and intaking, ~~Mabe~~ Maybe even adding cube capabilities.

Continued to Page

SIGNATURE Cameron L

DATE 10/6/2016

DISCLOSED TO AND UNDERSTOOD BY Marsel Nyar

DATE 10/11/16

PROPRIETARY INFORMATION

TITLE Build Log # 16 PROJECT

Continued from Page

Today we continued our work on preparing the launcher for consistent and reliable use. We disassembled all of the gears from the launcher and made sure they weren't chipped and that their axles were still straight.

Next, we sollidified the center launcher C-channel, because until now it was only mounted with three screws and keps-nuts. Now, it has six lock nutted screws and is very sturdy, hopefully helping resolve some of our bending issues. We also added a potentiometer onto this bar to allow us to monitor the position and movements of the arm.

Finally, we went through the lengthy process of putting our launcher back together, and properly putting spacers on. The intention is that now that we took the time to do everything right, we won't have anything slipping and breaking and we shouldn't have to disassemble the launcher for repairs anymore. The last few meetings have been slow and painful repairing the launcher, but the effort will pay off now that we should be fully functional.

With only three meetings left until the first competition, we are finally in the process of finalizing the robot. Before the competition, we hope to finish the following:

1) Diagnose issue we've found where one drive wheel randomly spins at full speed
2) Automate arm pulldown & launch with potentiometer
3) Enchance intake and make sure it runs as smooth as possible
4) Program autonomous modes & programming skills
5) Get practice on the field with the other competing teams

Continued to Page

SIGNATURE Cameron L DATE 10/11/2016

DISCLOSED TO AND UNDERSTOOD BY Michael Nyn DATE 10/18/2016

PROPRIETARY INFORMATION

TITLE Build Log #17 PROJECT

Continued from Page

Today we continued work on the code for our launcher. We programmed two asynchronous (from the usercontrol task) tasks that we plan to use to automatically handle pulling the arm down after we launch, allowing us to focus on driving to the next star. These tasks include taskLaunch and taskLauncherReset, which are used in combination to acheive the desired outcome. Here are the control flows for the two tasks:

taskLaunch: 1) Sets launcher motors to pull down the arm
2) The task monitors the arms potentiometer, comparing the current value against the last. If it notices the arm moved up, it moves on to the next steps. We know we started launching.
3) Sets launcher motors to stop spinning
4) The task monitors the arms movement as it launches the payload. It watches the movement until it detects that the arm has stopped launching, meaning we're ready to reset.
5) The task starts taskLauncherReset, then terminates

taskLauncherReset: 1) Arm potentiometer value is noted, and then a constant value is added to it. This value is used to detect how far we need to go down.
2) Arm motors are set to pull arm down
3) If the arm potentiometer is within a certain distance from the target, the code continues. Otherwise, it continues to wait.
4) Launcher motors are set to stop, and now the arm is ready to launch again.

These tasks should let us eliminate human error from the pulldown process, eliminating wasted time and misfires from...

Continued to Page 42

SIGNATURE Cameron L

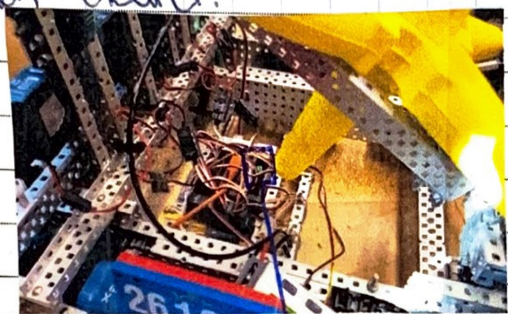
DATE 10/13/16

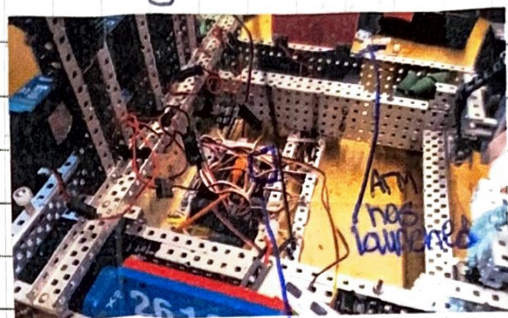
DISCLOSED TO AND UNDERSTOOD BY Michael Hyn

DATE 10/18/2016

TITLE Build Log #17 **PROJECT**

Continued from Page 41 holding the pulldown button too long. We wanted to test the effectiveness of this code, so we put an LED on our robot, and simulated a launch by manually pulling the arm down and releasing it. We had the LED turn off when it detected the arm going up, or essentially when step 2 of fastLaunch completes, described on the previous page. This seemed to work, but everything happened too fast to see. Ian had the great idea of recording in slow motion on one of our phones to better see the change, and the result was much clearer.





LED is on as arm is down

LED off

We learned that we weren't checking frequently enough, as the code didn't detect the launch until the arm was about half way up. We included a wait of 20ms in the loop, because we are used to things taking a large amount of time; however, the arm launches in about 1/4 a second, or 250ms. And since we required seven passes, it would take at least 200ms to detect the arm movement. We will need to find a way later to check much quicker without having misreads due to sensor inaccuracies.

Today we also fixed the drive issue that has been bugging us for a few weeks now. We've tried multiple motors, motor controllers, and even different Cortex's. It turns out, integrated PID somehow got enabled in our programs, and we've overlooked it this whole time. It's looking like next meeting we will be able to scrimmage or start autonomous testing.

Continued to Page

SIGNATURE Cameron L

DATE 10/13/16

DISCLOSED TO AND UNDERSTOOD BY Michael Ryan

DATE 10/18/2016

PROPRIETARY INFORMATION

TITLE Build Log #18 PROJECT

Continued from Page

At today's meeting we took our robot onto the field for the first extended time. Previously, we only had the robot on the field for at most 5 minutes to test individual subsystems. Since we are the only east team currently competition-able, we weren't able to scrimmage. Instead, we used this time to practice driving and predict any flaws the robot might have that we haven't caught yet.

We learned a few things about our robot in doing this. One thing was that even though they're pretty light, our robot can't even push cubes due to our 1:2 drive ratio. This will change our auton strats, as we planned to descore the cube from the farzone.

Another thing we learned is that every once and a while, intaking a star would get stuck under the intake, jamming the launcher. We hope to fix this by adding a platform of sorts on which the prongs of the star can rest, keeping our shots consistent and reliable.

We also got an idea of some important consumption values. We predict the rubber bands on our catapult would likely last two matches; however, to be safe, we plan to switch them every match. We also learned our batteries could last a few matches, but there is definetly a noticeable performance improvement with fresh batteries.

With the first competition in less than a week, we're all excited to compete. We only have one more meeting until the comp, so we hope to spend next meeting programming auton routines and practicing driving.

Continued to Page

SIGNATURE Cameron L

DATE 10/18/2016

DISCLOSED TO AND UNDERSTOOD BY [illegible]

DATE

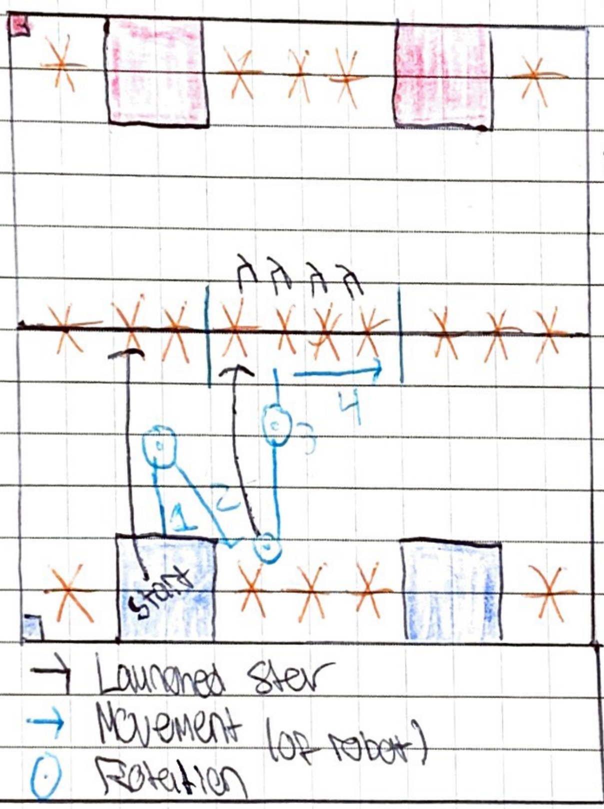
PROPRIETARY INFORMATION

TITLE Build log #19 PROJECT

Continued from Page

Today, we learned we will be meeting tommorow to scrimmage. We're still the only competition ready bot, so we aren't scrimmaging today either.

Today we worked on programming our primary auton routine, which has now been improved to match our robot:



- Depending on which side we start, the directions will reverse. For this example, it's the left side.

Start) Our robot deploys the intake, then launches our preload.

1) Robot drives forward, turns, and moves toward middle stars
2) Robot picks up closest star, and launches it over the fence, possibly hitting stars off the wall.

(from here on is experimental, and might not be working by the first comp)

3) Drive toward wall, then turn 180° and hit stars off wall
4) Move slightly over, and hit the other stars off the wall

With this auton, assuming we hit 2 stars with every shot, this auton can score up to 12 points, but realistically we will score around 6 points a round. Hopefully, we can finish the whole auton before the competition. Today we had a lot of encoder issues, so we moved to driving for a certain time until we can fix these methods.

Continued to Page

SIGNATURE Cameron

DATE 10/20/2016

DISCLOSED TO AND UNDERSTOOD BY Michael [illegible]

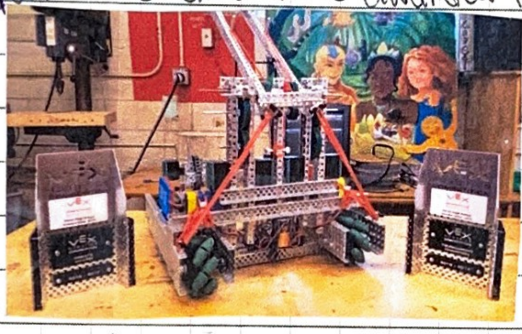
DATE 10/22/16

PROPRIETARY INFORMATION

TITLE Union High Competition Log PROJECT

Continued from Page

Today we had our first competition. We qualified for States by winning the tournament with 3815M and 3815J. We also placed first in programming skills with 8 points, and fourth in driver skills with 15 points. We also were awarded the Create award.



Although tecnically we did very well, our robot had many fatal flaws throughout the competition. These flaws include:

- Stars would get dropped under our catapult arm when it was up, completely disabling our launcher
- Our encoder methods had many issues, causing us to miss the second star in auton about 50% of the time
- The crossbar of our intake would kick stars away when we tried to intake
- The prongs on our intake were too short, making it very difficult to intake
- The shafts on our drive occasionally jammed up, causing us to stall, so we would have to drive, wait for the motors to cool, and then drive again.

We had all of these flaws, but our auton worked well and our launcher worked great when we were actually able to intake. Since the launcher still works well, we hope to fix the above issues in the slightly over two weeks we have until Rowan.

Continued to Page

SIGNATURE Cameron L

DATE 10/22/2016

DISCLOSED TO AND UNDERSTOOD BY Michael Ryan

DATE 10/27/16

PROPRIETARY INFORMATION

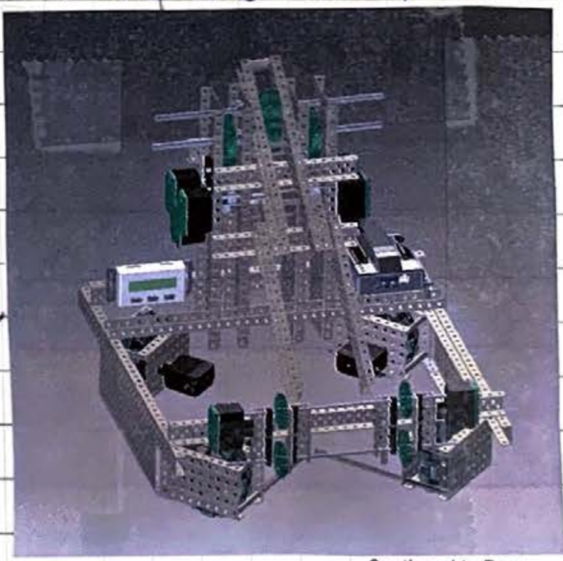
TITLE Build Log #20 **PROJECT**

Continued from Page

Today we started work on the improvements for the issues we had at the tournament. The first thing we did was elongate the prongs on the intake. We tested this on the field, and it made picking up stars lot easier. We probably should have done this a while ago, as it was suggested by many people, but we never got to it. We also added standoffs so that the intake always stopped at the right position for pickup, making intake much easier. After the above improvements, we can now pick up 1 star about every 3 seconds, when it took us about 15-30 seconds at the tournament if the star wasn't perfectly oriented.

We also noticed that with the longer standoffs, we can almost pick up stars from any direction instead of only 1/2 of the possible orientations. At the moment it doesn't properly flip into our intake but we hope to make it work next meeting.

We also started to look for parts to build an X-drive. We've observed that they seem to strafe and drive much smoother than Mecanum wheels do. Also, our 1:2 drive was slightly too fast, so the 1:1.414 ratio of an X-drive. Since we only have two weeks until the next competition, we might not have time to finish the drive before the competition; however, we have the X-drive (and future launcher) designed in CAD, so once we get the parts together, it shouldn't take long to put together.



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SIGNATURE Cameron L DATE 10/25/2016

DISCLOSED TO AND UNDERSTOOD BY Michael Ryan DATE 10/27/16

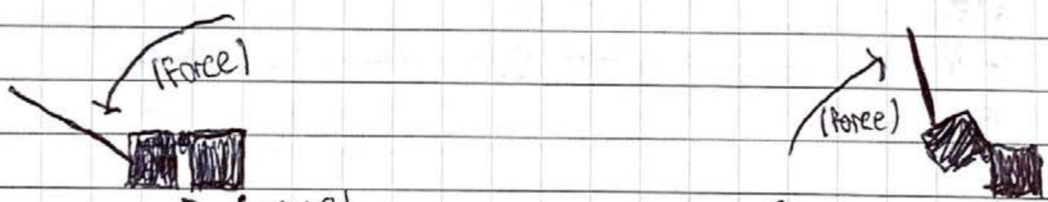
PROPRIETARY INFORMATION

TITLE Build Log #21 **PROJECT**

Continued from Page

Today we continued work on the new X-Drive. Last competition our drive was failing randomly, and today we figured out why. One of the internal gears of one of our gears was mismatched causing some slippage. Also, a certain motor controller was occasionally dying out, likely causing the drive to stall out. The new drive should drive smoother but also be able to do maintenance on it if issues like this happen again, because the motors are much more accessible.

Before today, our intake would get jammed if we tried to intake a certain orientation. Today, we put the intake on hinges, so after it lifts it's able to pull out of the star without jamming. This will be very useful in competition, as we won't need to worry about getting the right orientation.



When lifting up, the intake locks and doesn't fold up.

When going back down, if there's any resistance, the intake gives way and folds up

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SIGNATURE Cameron L

DATE 10/27/2016

DISCLOSED TO AND UNDERSTOOD BY Michael Ryan

DATE 11/6/16

PROPRIETARY INFORMATION

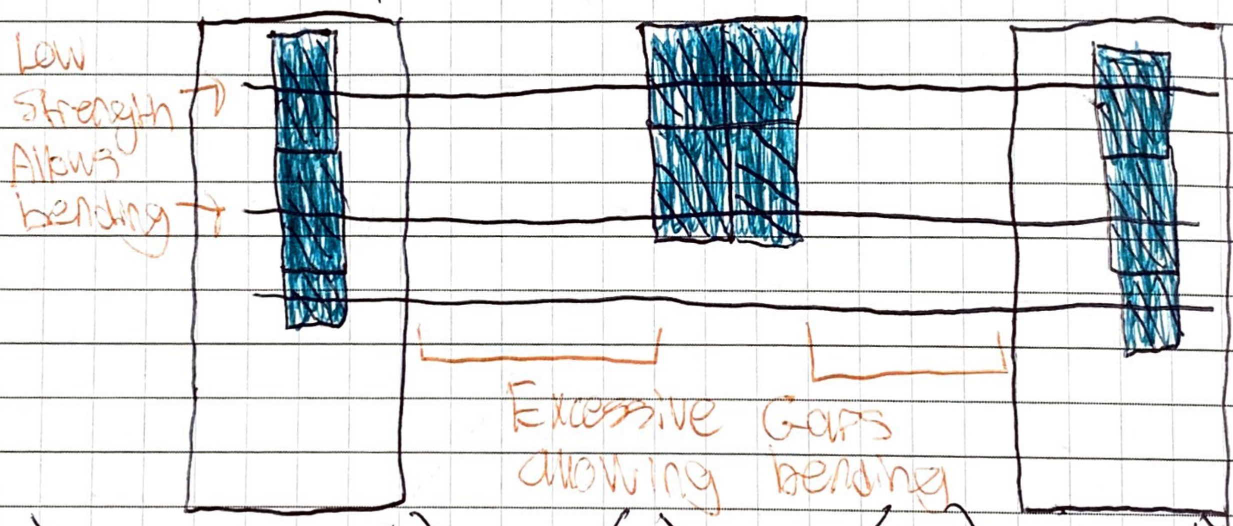
______ - 48
BOOK PAGE

TITLE Build Log #22 PROJECT

Continued from Page

Today we finished our X-drive. It drives much nicer than our old drive which should make getting stars a lot easier. The drive strafes as easily as it drives, which is much nicer than our mecanum drive strafing. Also, the drive was designed in such a way that moving the intake and launcher to our new bot will be effortless.

We also began to rebuild our launcher to fix bending that has been occuring. Although it worked, we had to replace certain axles after competitions. The new ~~intak~~ launcher will utilize a high-strength axle as well as be more compact to eliminate large gaps in the axles.



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SIGNATURE Cameron L | DATE 11/11/2016

DISCLOSED TO AND UNDERSTOOD BY Michael Kyn | DATE 11/6/16

PROPRIETARY INFORMATION

TITLE Rowan University Competition Log PROJECT

Continued from Page

Today we had our second competition of the season. We had a fatal issue with our launcher before the competition, leaving us to compete as a pushbot. The force of our launcher was bending our drive superstructure when it pulled down, bending almost 25° from where it should be. This misalignment kept our auto-pulldown from working, which would've forced us to manually pull down the catapult, which results in misfires about 3/4 of the time.

With the scoring system out of action, we decided to create a strategy as a pushbot to be as effective as possible, in hopes to damage our allies as little as possible. Little did we know, our new drive proved very effective for pushing, and we could push upwards of 6 stars under the fence. We managed to place 4th in qualifiers, only losing one of six matches. The match we lost was by a score of two, and was against one of the best teams, 3815M. We also managed to adapt our auton a few times, allowing us to still be competitive in auton without our launcher.

We were awarded the Think award by the judges for our LERP drive correction, described on pages 29-30. We were really proud to get recognition for the robot's programming. We put a lot of work into our software, which at most competitions is overlooked. This will definitely encourage us to try more non-regular solutions to problems through software to make operating our robot as easy as possible.

Although today's issue wasn't due to the intake, we've realised that even if it was, we wouldn't be able to keep up with the top teams at the competitions. Because of this, we've decided it's probably best to rethink our robot. We're not sure what we'll do yet, but we expect to do a major redesign before the next competition.

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SIGNATURE Cameron L

DATE 11/6/2016

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DATE 11/17

PROPRIETARY INFORMATION

TITLE Missing Meetings & Info **PROJECT**

Continued from Page

Over the past week and a half, we've been putting all of our time into the robot. Since we don't have a dedicated person for our notebook, we ended up missing some important changes about our robot.

We began work on PID driving for autonomous, which seems to be working very well. Although we used encoders for previous autons, we still drifted and ended up missing game objects. PID should let us be more concise, and allow us to drive faster when slow speeds aren't needed, giving us more time to score.

We also had an unofficial build meeting on 11/5/2016, where we worked on our launcher, replacing a broken motor and tweaking it a little. Sadly, we didn't notice the bending we experienced today. Although our robot failed the next day at competition, this meeting gave us a lot of practice with our bot.

There was also a meeting on 11/3/2016, which was used to rewire our robot and prepare it for competition. We attached batteries, made basic autons, and did testing on most of the robot's systems to be sure we were ready to compete.

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SIGNATURE Cameron L

DATE 11/6/2016

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DATE 11/17

PROPRIETARY INFORMATION

TITLE The Clawncher PROJECT

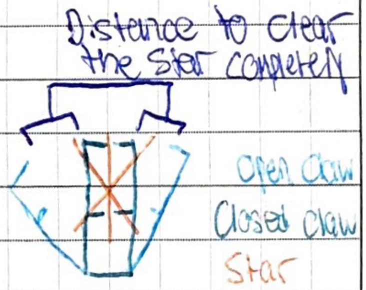
Continued from Page

Today, Michael and I met to test some basic things with some concepts we have for a new design. There was a robotics meeting on the 8th, but we mainly just talked about the competition, and possible designs to change our robot to. There was no meeting on the 10th because there wasn't school.

The team has decided that, although challenging, we're going to attempt designing a "clawncher" (claw launcher.) We discussed a few challenges with this design, which are as follows:

- __Weight__: Our current launcher arm is very light, which is what lets it be so fast. A clawncher would likely be much heavier, especially since the claw grabbers alone would be more than our current arm weighs.

- __Claw speed__: With a clawncher, time is very crucial. Based on the current slow-motion videos of our launcher, a launch takes about 0.75 seconds to do a full swing. This means that we need to, in 0.75 sec, transfer enough energy into the star to launch it, and open the claw enough to release the star or cube we're launching. This will likely be the hardest thing to achieve.



- __Timing__: As stated above, the release of a star with a clawncher needs to be perfectly timed. This will take very good programming to get right, and will rely on the sensors updating quick enough to be useful.

Continued to Page 52

SIGNATURE Cameron L | DATE 11/13/2016

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PROPRIETARY INFORMATION

______ - 52
BOOK PAGE

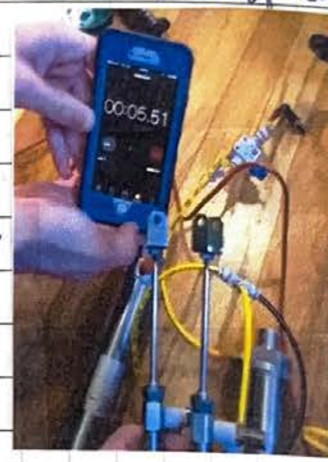
TITLE The Clauncher PROJECT

Continued from Page 51 As stated on the previous page, opening the claw needs to be as fast as possible. We didn't think motors would be fast enough, so we decided to take a slow motion video to figure out how quick pneumatics are, and to see if they could be fast enough.

$5.44s \to 5.51s = 0.07s$

0.75s - Launch Time
\- 0.07s - Piston Time
0.68s Leftover Time to introduce force

→



Assuming the piston slows to twice it's normal open time when under load, we would still have ~0.60s to put energy into the star before releasing, or 80% of the launch time. This is very reassuring, because the pneumatics are much faster than we expected. The only downside is, that according to the forums, two pistons will only get 20 sets of open/closes on a full tank. Some ways we could fix this are ① Making the pistons only act in one direction, and use elastics in the other direction ② Finding a way to use 1 piston for the whole claw

Option one would likely work, but might hinder our speed of opening. Option two might also work, however it might not have enough force to pull a lot of stars into it. Next meeting, we'll work on trying to design a light and fast claw, hopefully using one of the two solutions mentioned.

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SIGNATURE Cameron L DATE 11/13/2016

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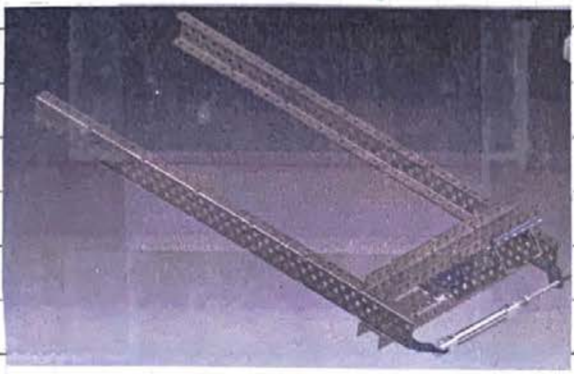
PROPRIETARY INFORMATION

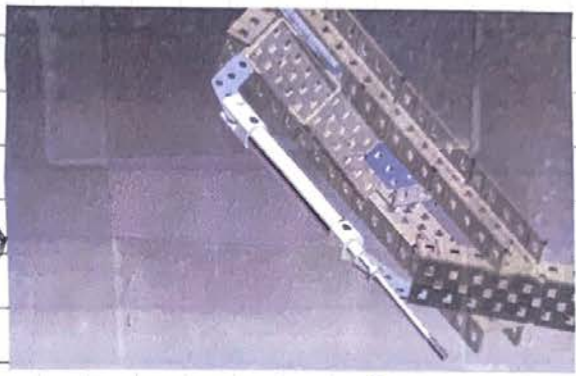
TITLE Build Log #23 PROJECT

Continued from Page

Today we started work on our claw. We decided to do a pneumatic claw, and came up with a design that uses one piston for both arms:

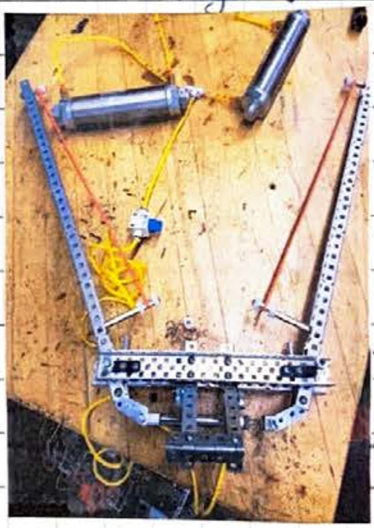


Piston extended, claw closed



Piston retracted (although it doesn't look in CAD), claw opens up

The claw opens very fast, and with initial testing, it seems we can hold 3 stars or a cube without issue. It's very strong, so we should be able to grab stars with a large grip without issue. Next Meeting, we hope to dissasemble our old launcher arm and intake, and test different intake positions. We also hope to test various things about the claw, including weight and speed.



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SIGNATURE Cameron L DATE 11/15/2016

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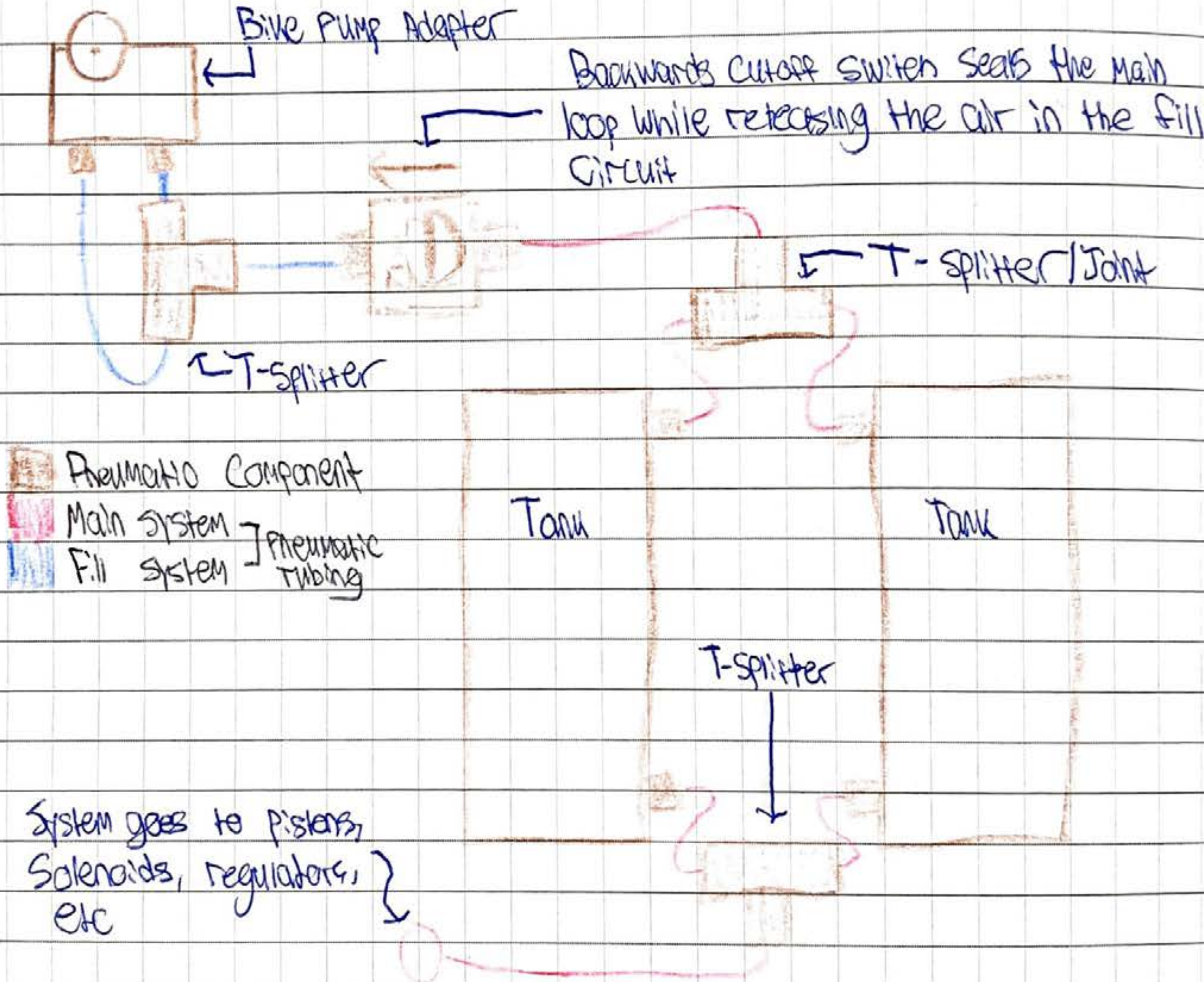
PROPRIETARY INFORMATION

TITLE Pneumatic Fill Circuit **PROJECT**

Continued from Page

When filling up our pneumatic system, we've noticed we lose a lot of air when we take the bike pump off the tank; a similar issue to what we had last year. To solve this problem, we designed a fill "circuit" that cuts the fill section off when it's time to disconnect.



This setup should allow us to maintain all of the air we fill the system with, and not have to worry about losing too much air when we disconnect the pump.

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SIGNATURE Cameron L

DATE 11/16/2016

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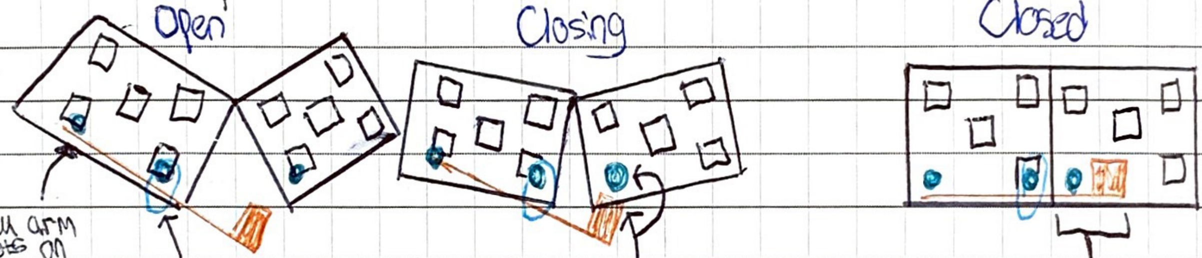
DATE 11/17

PROPRIETARY INFORMATION

TITLE Build Log #24 **PROJECT**

Continued from Page

Today we worked on the locking mechanism for our claw and arm. Since we have a pneumatic claw, we can't fold our arms back like teams with motorized can. The locking mechanism allows our arm to fold backwards onto our robot, letting us fit in 18x18x18 inches. We decided to use a design made by "Chris Olson" (team unknown) because unlike many other locking mechanisms, his design holds very solid when locked and doesn't slip



Lock arm pivots on pillow bearing

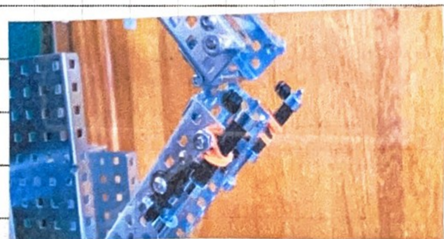
Elastics pull up on lock arm keeping it in place

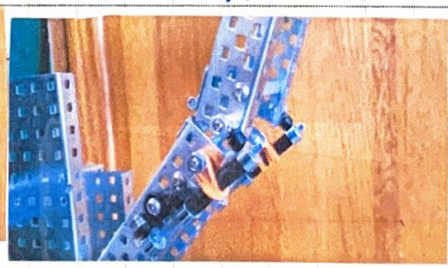
When closing, standoff pushes locking arm down

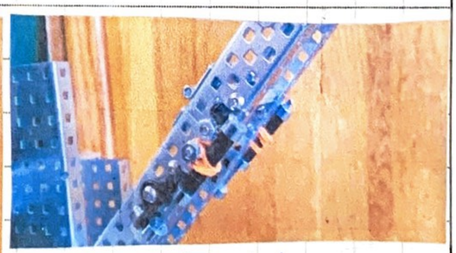
Lock arm passes the standoff and closes behind it, preventing re-open

With our tests, we were able to shove the arm as hard as we could without it unlocking. Also, to engage the lock, very little force is needed, which should make it very easy to deploy. Over the weekend we hope to attach the arm to the robot for basic driving testing.

Images from Chris Olson's demo video


Open


Closing


Locked

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SIGNATURE Cameron L

DATE 11/17/2016

DISCLOSED TO AND UNDERSTOOD BY Michael Ryan

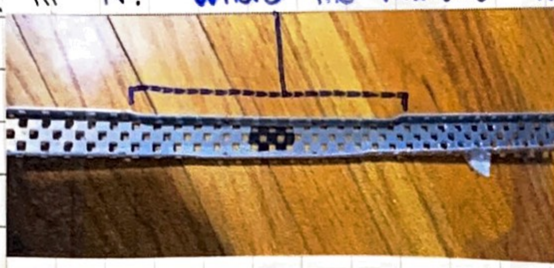
DATE 12/1/16

PROPRIETARY INFORMATION

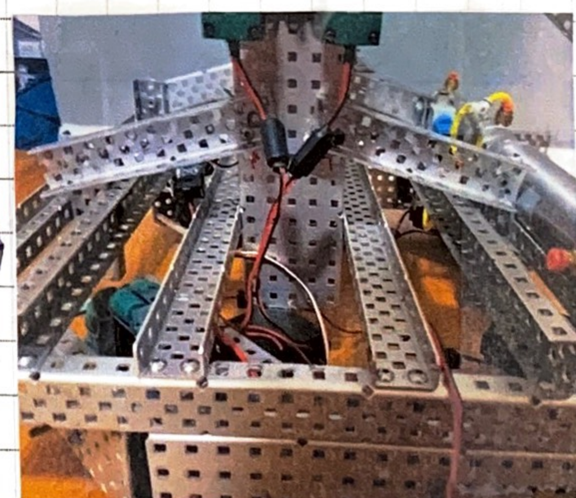
TITLE Build Log #25 PROJECT

Continued from Page

Today we disassembled the old launcher arm and structure. The bending on page 49 turned out to be better and worse than we thought. Somehow we only managed to bend one C-channel, however the bending was very extreme: twisting the metal and imprinting the launcher stack in it. Where the launcher was mounted



Due to this extreme bending, we spent today designing ways to fix the issue. Before we only had two ~~standoffs~~ C-channels holding the launcher in place. This worked for our first catapult, but the new design was too powerful, bending this metal. To prevent this from happening, we added 2 C-channels per side of the launcher, preventing it from rocking back and fourth. By testing with our hands, it's clear that the launcher is much more solid. Hopefully, it'll be strong enough for our claluncher.



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SIGNATURE Cameron L

DATE 11/22/2016

DISCLOSED TO AND UNDERSTOOD BY Michael Ryan

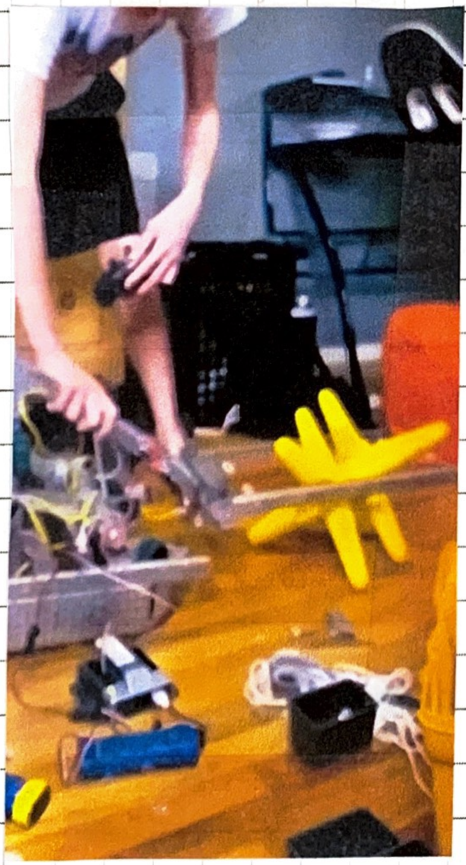
DATE 12/1/16

PROPRIETARY INFORMATION

TITLE Launcher Proof of Concept PROJECT

Continued from Page

Today we wanted to test the Concept of the claw releasing stars when launching. The launcher wasn't Motorized and there weren't any sensers on the arm yet, so everything was done by hand. Because of this, it's hard to say the whole system was proven, but now we know for sure we can release the stars fast enough to launch them long distances.



During these tests, we also noticed a few things to fix over the next few Meetings:

- The robot needs more weight to keep it down when shooting
- The claw pivots a bit on the hinge, and needs more support
- The current solenoid mounting makes the left claw arm slower than the right arm, causing desync

Continued to Page

SIGNATURE Cameron L

DATE 11/25/2016

DISCLOSED TO AND UNDERSTOOD BY Michael Nyon

DATE 12/1/16

PROPRIETARY INFORMATION

PROJECT

TITLE Build Log #26

Continued from Page

Today, we didn't get too much work done. It was the first day back from break, and we spent a large portion of the meeting setting the field up. We did some minor testing, and made some plans for next meeting:

- To increase stability on the launcher stack, we will replace the triangle support described on page 56 with a straight bar across

- We will test some "choo-choo" launcher designs, with the assumption that the force we have would be too much for slip gears to handle

Over the next week, we hope to get our launcher and claw working for the competition. At the past two competitions, our robot was never fully functional. This was due to undertesting, as well as the fact we've been using more experimental designs. If we can get our robot functional within a week, we should have plenty of time to test and prepare our robot for competition.

Continued to Page

SIGNATURE Cameron L

DATE 11/29/2016

DISCLOSED TO AND UNDERSTOOD BY Michael Ryan

DATE 12/1/16

PROPRIETARY INFORMATION

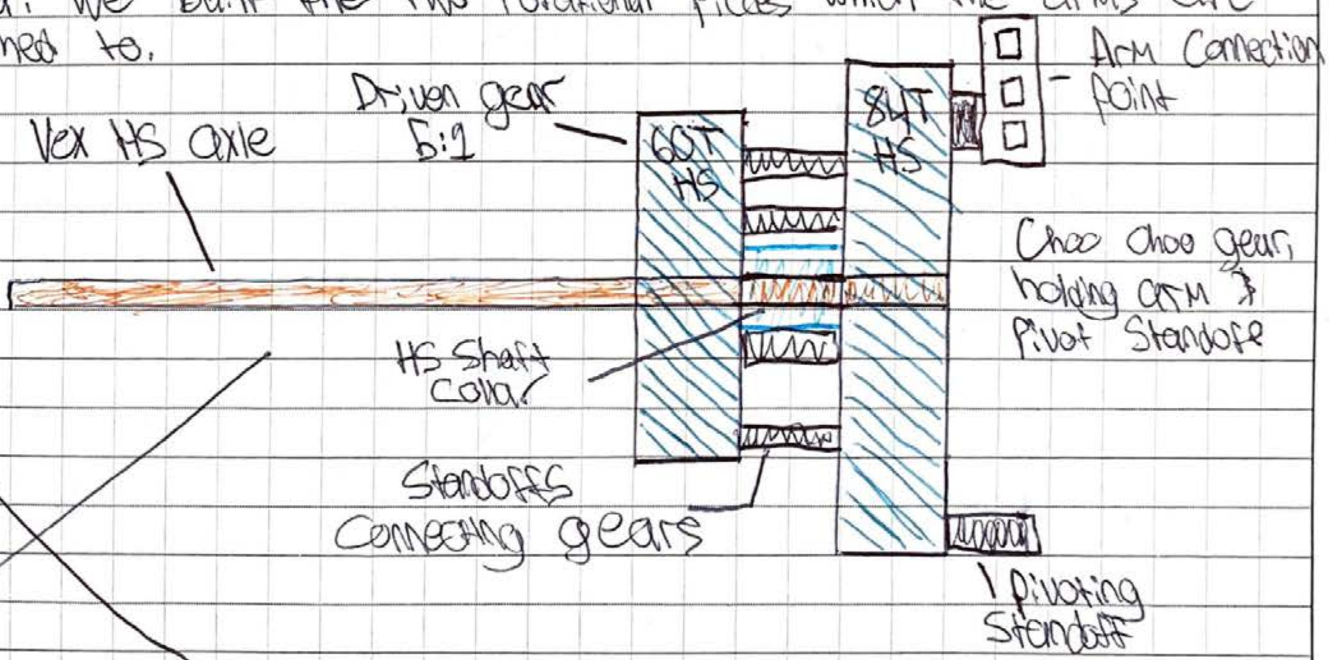
TITLE Build Log #22 PROJECT

Continued from Page

Today we prepared our robot for the new launcher. To launch 3 stars or a cube, our launcher will need a lot of rubber bands. With testing, we figured out that the supports described on page 56 are still not strong enough. So they were replaced by solid straight bars across the robot. This should increase stability significantly.

We also dissassembled the old launcher stack, including the motors and all of the bearings we had on for the slip gears. Suprisingly, the screws and nuts made a significant weight difference on the robot. On each channel we had 7 bearings. With 4 channels, we had 28 screws and nuts. It's easy to overlook things like this, and we will now definetly consider the weight of having so many bearings.

Today we also began assembling the pieces of our choo-choo launcher. We built the two rotational pieces which the arms are attached to.



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SIGNATURE Cameron L

DATE 12/1/2016

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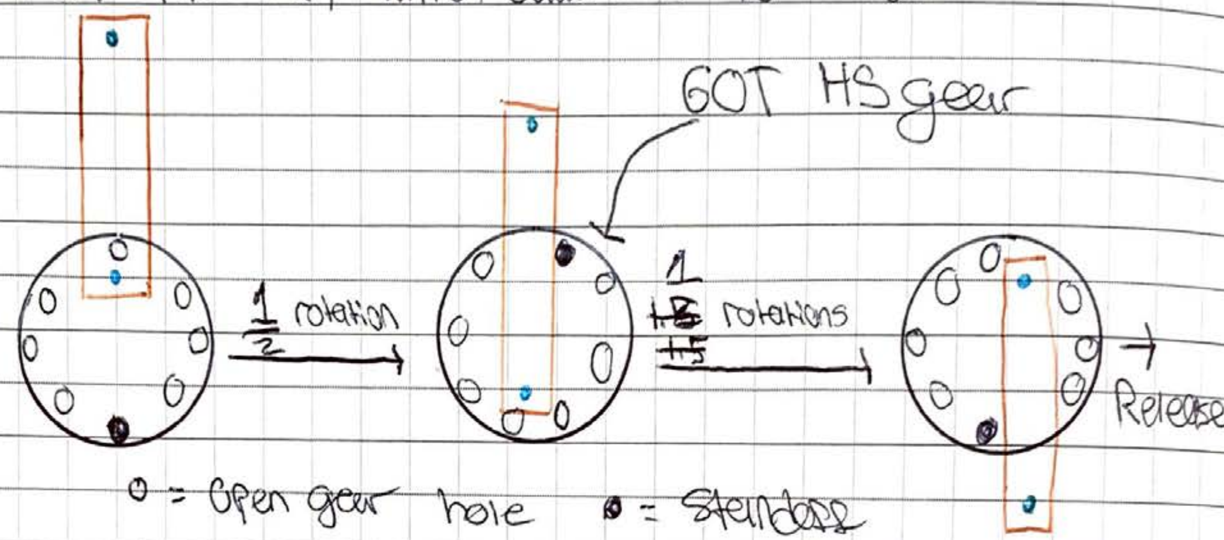
DATE 12/10

PROPRIETARY INFORMATION

TITLE "Choo Choo" launcher PROJECT

Continued from Page

In previous pages, we have talked about using a "Choo Choo" style launcher. These consist of a rotational gear, as well as a two bar linkage. The bar attached to the gear determines how far the launcher pulls down, ~2x it's length. The gear also has a standoff on the opposite side of the gear from the bar, which causes it to "fold"



This launcher system has quite a few advantages over a slip gear which is why we decided to switch. For one, it can handle a lot more force. Slip gears put all the force on the teeth of the gears, which causes a lot of issues with snapping. Also, slip gears require ratchets if you want a reasonable pulldown time; however, Choo Choo launchers fold up, and don't need a rachet to stay down when primed.

Continued to Page

SIGNATURE Cameron L

DATE 12/4/2016

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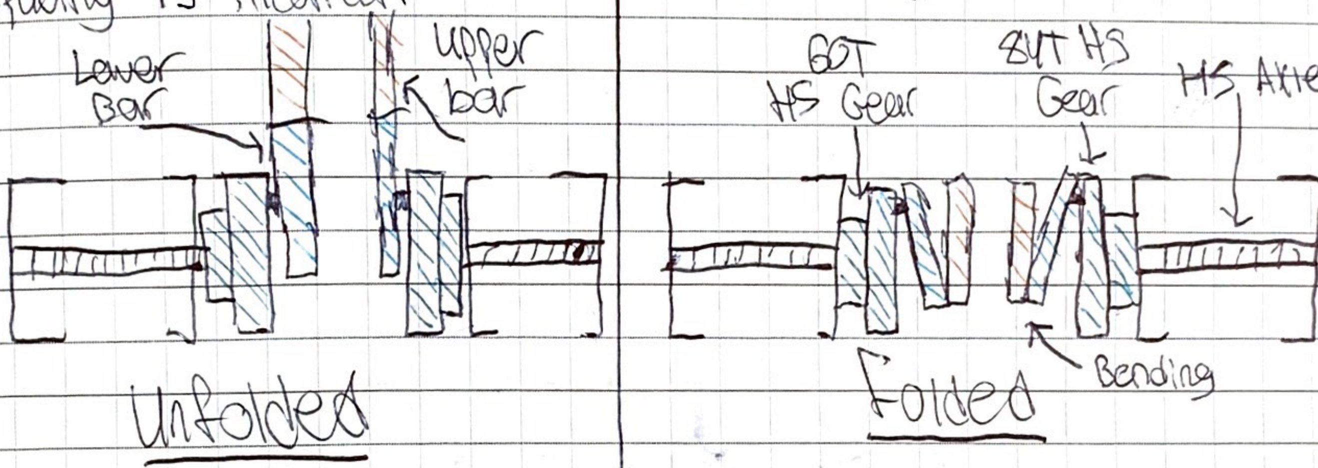
DATE 12/10

PROPRIETARY INFORMATION

Continued from Page

Today we finished the prototype of the choo choo launching mechanism. With some initial testing, we are able to launch a single star from far to far zone. With a reduction of friction, we believe we should at least be able to launch two stars far to far zone. One issue we are noticing is that when our choo choo folds down, the bars fold inwards and don't remain parallel. We think this might be due to the gears bending, or that the spacing is incorrect.



With the competition coming up this weekend, we have very little time to get this robot functional and competition ready. Luckily, we believe we're very close, and have a short list of changes:

- Fix bending of launcher arms
- Reduce friction of gears
- Program auto release

Continued to Page

SIGNATURE Cameron L
DATE 12/6/2016

DISCLOSED TO AND UNDERSTOOD BY [illegible signature]
DATE 12/10

PROPRIETARY INFORMATION

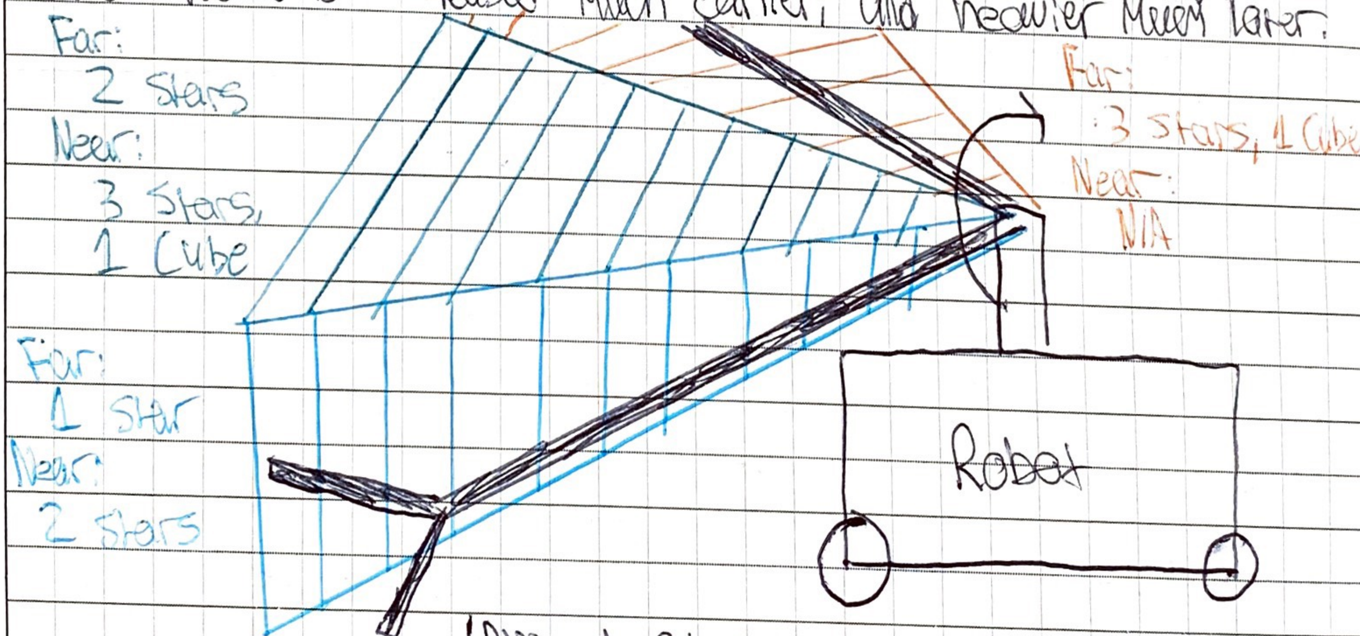
TITLE Variable range release **PROJECT**

Continued from Page

After some testing with the launcher, we've seen that we might be able to pick the general area we launch into by programatically changing the release time of the claw. This would be very useful: This would let us decide the amount of stars we launch, and allow us to use one set of elastics for various launch types.

To achieve similar results, most other teams have needed to use multiple small launcher arms, and they would release them in different combinations to get different distances. This makes it very hard to launch with different loads, because if the load wasn't heavy enough, they would often overshoot.

The way we plan to accomplish such control is by releasing the star load from our claw at different times. Lighter loads would be released much earlier, and heavier much later.



(Different colors represent different release periods along the launch arc, and what they could possibly launch)

Continued to Page

SIGNATURE Cameron L

DATE 12/7/2016

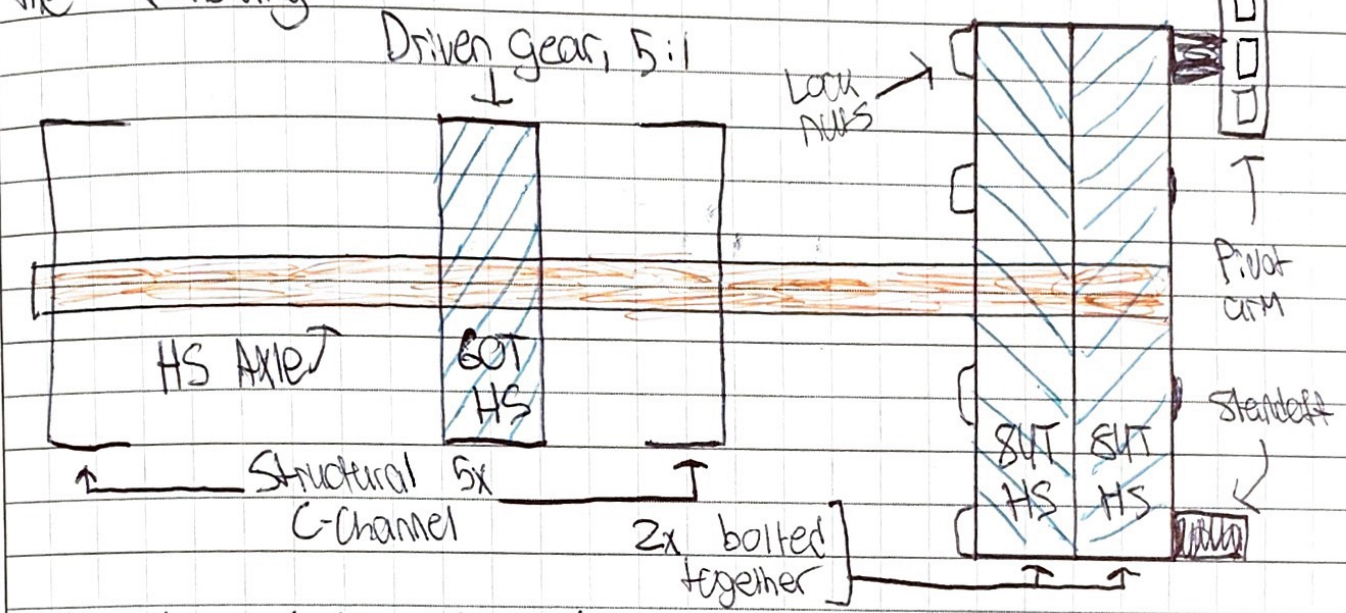
DISCLOSED TO AND UNDERSTOOD BY [signature]

DATE 12/10

PROPRIETARY INFORMATION

Continued from Page

Today we figured out most of the bending in our Choo Choo was due to the plastic gears bending. To solve this, we decided to change the design on page 59 to the following:



We learned that the two 84t gears bolted together allowed for much less flexing than the design on 59. Also, moving the driven 60t gear into the structural C-Channels reduced a large amount of friction on the pinions driving it.

We worked on some programming to rework our old pulldown code for the new launcher arm. Hopefully it shouldn't be too difficult, since the general concept is the same. With the competition in two days, we hope to spend tommorow programming and finalizing the changes for the competition.

Continued to Page

SIGNATURE Cameron L DATE 12/8/2016

DISCLOSED TO AND UNDERSTOOD BY Karen Cook DATE 12/10/2016

PROPRIETARY INFORMATION

TITLE South Brunswick Competition Log PROJECT

Continued from Page

After a lot of hard work, we had a very successful tournament today. Although at other tournaments we have placed higher, we can confidently say we carried our own weight. Also, for my first time in Vex history, we had a competition where we didn't do any building changes, and didn't cause any parts to break. This is a major achievement for us, and we spent a lot of time with this design to ensure it was reliable.

At today's tournament, we finished 6-2-0, finishing 7th in qualifications. We ended up being the captain of the 5th seat, taking 4610X and 4610B. Sadly, neither robot worked in finals, which ended up in us getting overwhelmed, loosing the quarterfinal. We also were awarded the Design Award, which was a major honor.

Today we competed with a very experimental design, and we did much better than we expected. We learned a lot about our design, and have a lot of plans for changes:

- Switch claw to be motorized. We'll need to test designs to get one fast enough. This should really help our intake ability.
- Change shape of claw. We'd like to be able to easily hold cubes and multiple stars, which will be needed to be competitive
- Reduce arm & claw weight. This will let us use more of our force to launch cubes and stars.
- Reduce overall weight. This should let us increase drive speed.

For the first time, we've decided we found a suitable design. The great thing about this is that we can now make much more complex autons, practice driving, and tweak the design to be much faster. In the past, we've spent all of our time rebuilding, so we barely had time for any of those things. The future is looking very good, and we hope we can finally put our programming skills into a complex programming skills.

Continued to Page

SIGNATURE Cameron | DATE 12/10/2016

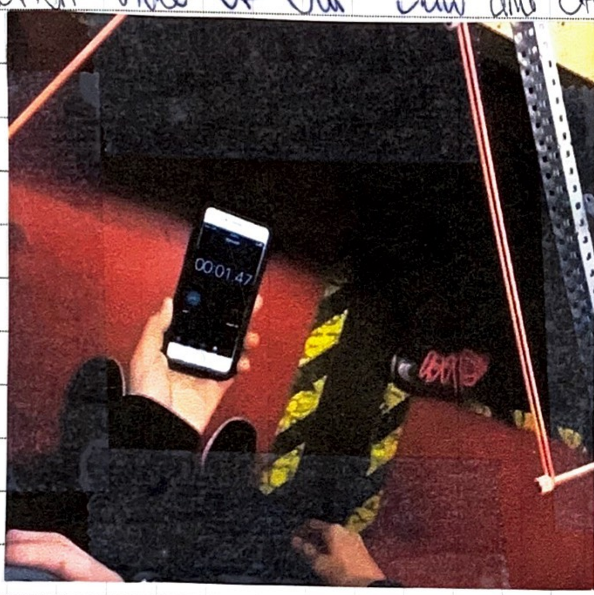
DISCLOSED TO AND UNDERSTOOD BY | DATE 1/7/17

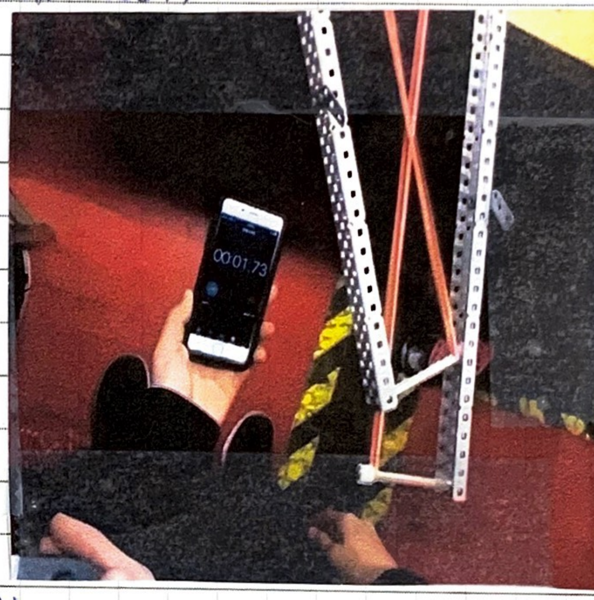
PROPRIETARY INFORMATION

TITLE [BL#30] Claw Design **PROJECT**

Continued from Page

Today, we started preperation for building a Motorized claw. For our clauncher to be successful, it needs to be able to hold multiple stars, grab cubes, and break up clumps; something our pneumatic claw just couldn't do with a single piston. To get a good idea of how fast a motor claw was, the fastest to have comparable speeds with our pneumatic claw, we took slow motion video of our claw and other ~~east~~ team's claws.





Our Pneumatic Claw

The results were suprising: Motorized claws aren't much slower than pneumatic claws:

Our claw close time: ~0.26 seconds

Motorized

D team close time: ~ 0.25 seconds ← (Actually faster than our pneumatic claw!)

K team close time: ~ 0.53 seconds

H team close time: ~ 0.47 seconds

Motorized claws have definetly proven themselves to us, and we are set on making the switch. We'll need to consider the weight of the setup, and keep it as light as possible. Hopefully, the motorized claw will release the clauncher's potential.

Continued to Page

SIGNATURE Cameron L

DATE 12/13/2016

DISCLOSED TO AND UNDERSTOOD BY [signature]

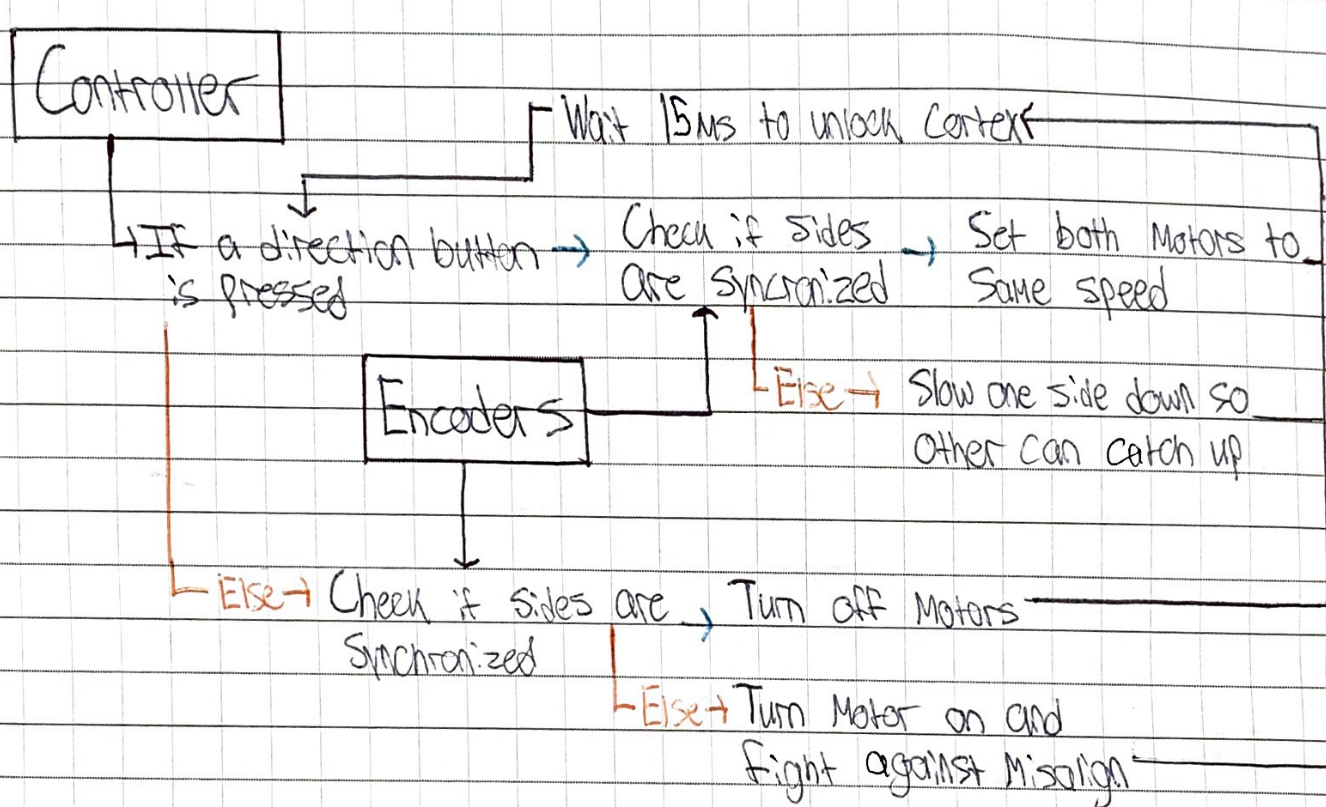
DATE 1/7/17

PROPRIETARY INFORMATION

TITLE [BL #31] Claw Syncing PROJECT

Continued from Page

To minimize the weight of our claw, we decided to not gear the two sides of our claw together, and instead use encoders to keep the sides in sync. This should reduce the weight significantly, because we will eliminate many gears, axles, bearings, screws, and nuts. We plan to use the following flow for synchronizing the sides:



Although very basic and bang-bang, we think this control loop is sufficient compared to PID for this case, as we don't need super precise and fast alignment, just to keep generally aligned. Hopefully next meeting we can finish our claw and test our code. If successful, this should give us a major advantage.

Continued to Page

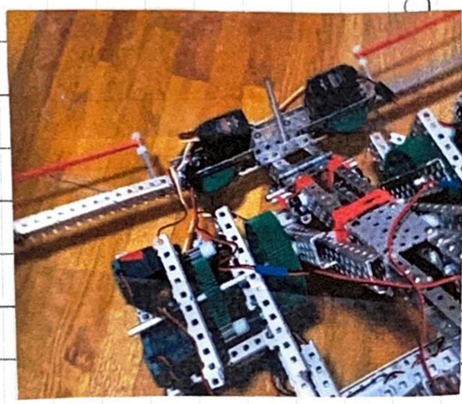
SIGNATURE Cameron L DATE 12/15/2016

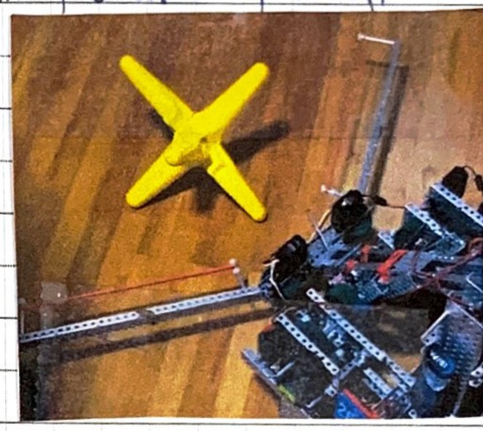
DISCLOSED TO AND UNDERSTOOD BY [signature] DATE 1/7/17

TITLE [BLH32] Finished Claw PROJECT

Continued from Page

At today's meeting, we finished building our motorized claw. We used a 5:1 ratio, with each claw arm having it's own motor (the two sides are unlinked and independent). We link the two sides with the method described on page 66. We decided to use the old light weight claw frame from our pneumatic claw. This allowed us to make the change with as little change to our pre-existing robot.





This claw lets us get two stars easily and 3 with some work, which is how much we expected to hold with the clauncher. Despite the efforts to make it as light as possible, it is still significantly ~~twi~~ heavier, which is concerning. We hope to be able to test the claw next meeting, and if it doesn't work (overall or fast enough), we have decided we might consider switching to a more conventional claw-type robot, giving us ample time to prepare for states.

Continued to Page

SIGNATURE Cameron L

DATE 12/28/2016

DISCLOSED TO AND UNDERSTOOD BY Michael Nyan

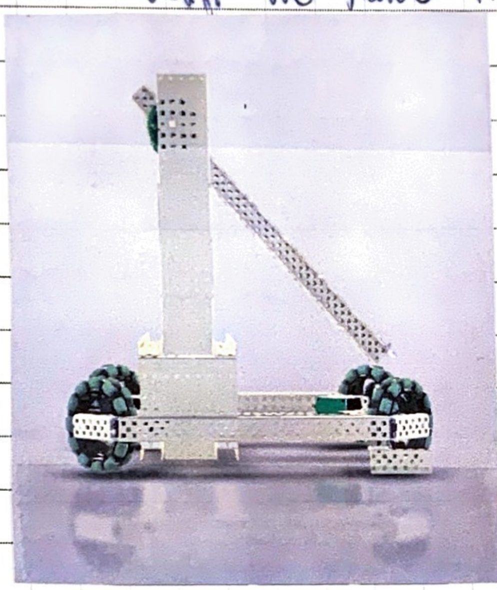
DATE 1/7/17

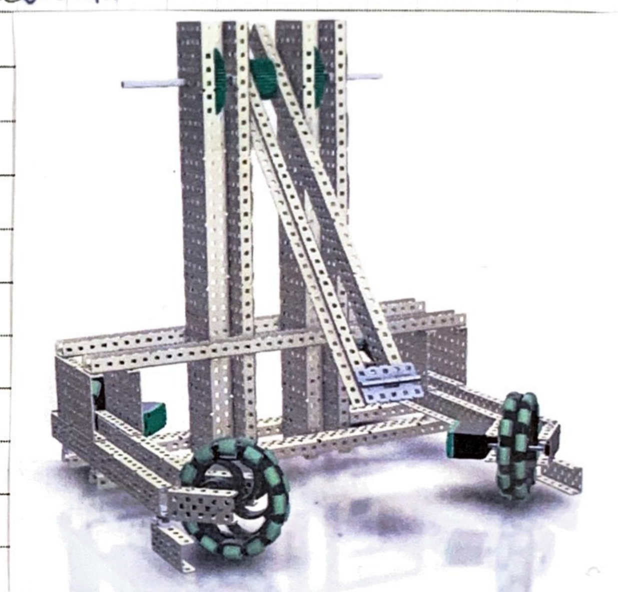
PROPRIETARY INFORMATION

TITLE [BL#33] Design Switch **PROJECT**

Continued from Page

Today, after testing our launcher with the Motorized Claw, we still noticed it had many shortcomings compared to standard claw lifting bots. Although for a long time we've been trying out experimental designs, it's getting closer to States but our clampers haven't caught up with the rest of the other popular designs. In the time we have been using experimental designs, we've kept in mind that they may never work, and decided to keep a secondary design ready in CAD incase the time came to switch. Today, we made that decision.





The CAD wasn't kept in super high detail as it was constantly changing. We are using a 5:1 ratio with 6 torque motors in a planetary orientation to maximize efficiency. Also, for quick building, we're using our claw and arm straight off of our clamper. Since these were designed to be light, they should suit the light X-drive design. Since the whole design was made to be minimalistic and light, we hope we will be able to high hang in the future for maximum scoring capabilities.

Continued to Page

SIGNATURE Cameron L

DATE 12/22/2016

DISCLOSED TO AND UNDERSTOOD BY Michael Ryan

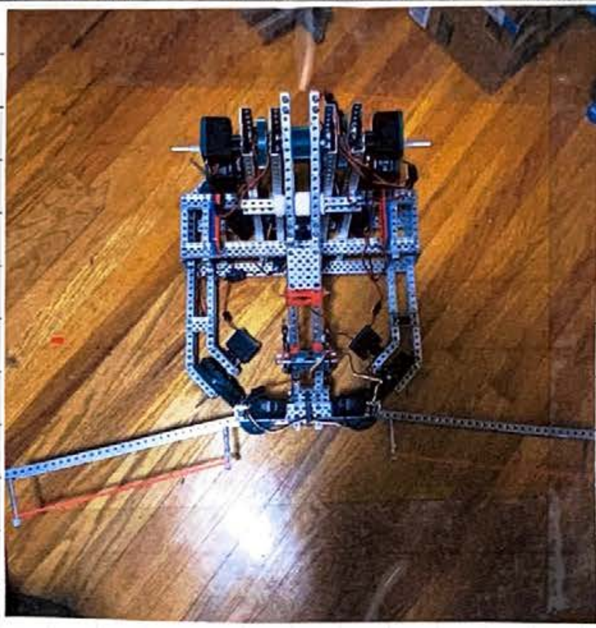
DATE 1/7/17

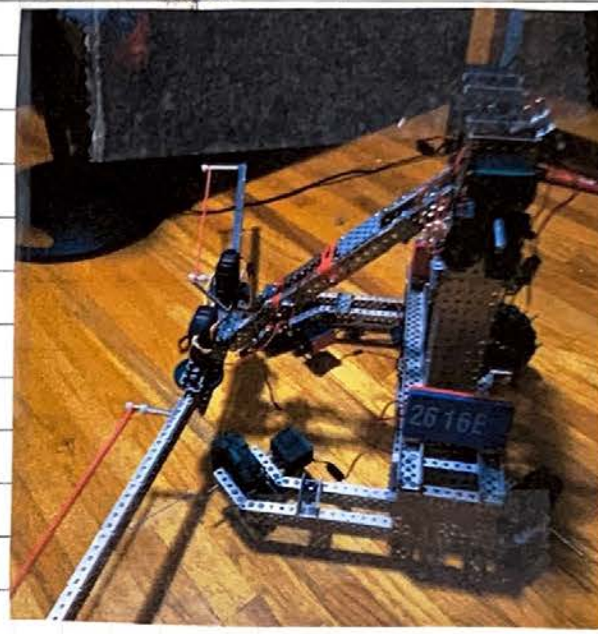
PROPRIETARY INFORMATION

TITLE [BL#34] Finishing Design **PROJECT**

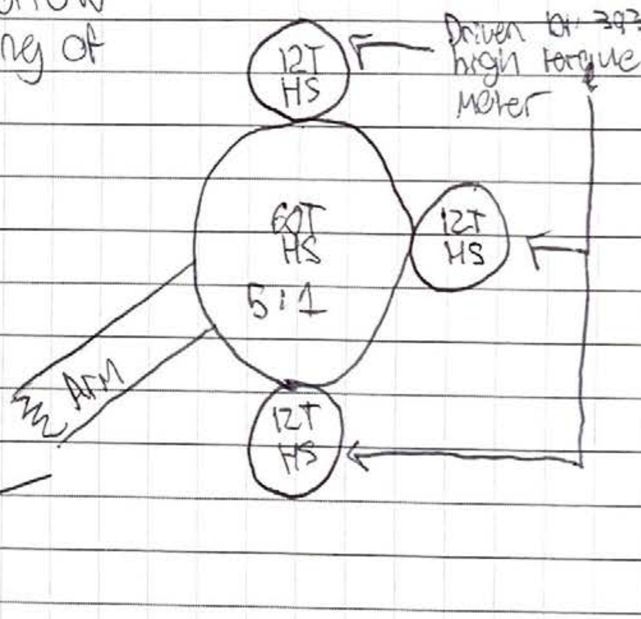
Continued from Page

Today we finished the majority of the new robot. Over winter break, since the frame is so simple, we finished the whole skeleton of the robot. Today, we attached all of the motors and wheels, and put our catapult arm on the bot.





With basic testing, the drive seems very effective, and the lift seems powerful. Tomorrow we hope to do further testing of how many stars we can lift, especially with our catapult-style rubber band assist. In theory, we should be able to lift much more than we need. We're all looking forward to compete at this weekend's tournament



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SIGNATURE Cannon L — DATE 1/3/2017

DISCLOSED TO AND UNDERSTOOD BY Michael Ryan — DATE 1/7/17

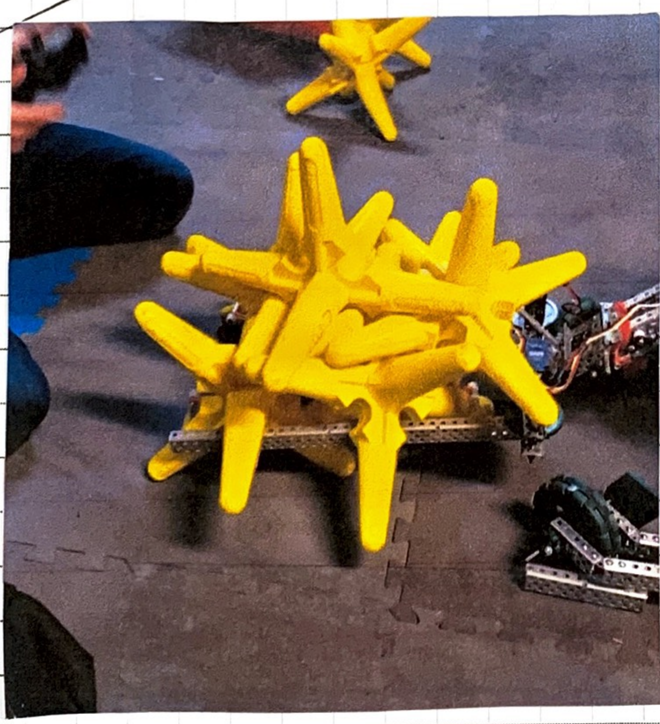
PROPRIETARY INFORMATION

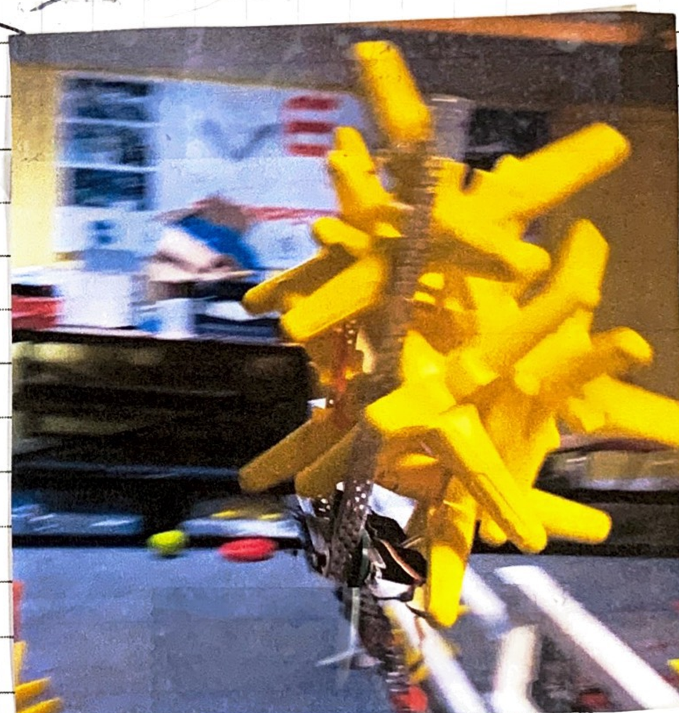
TITLE Design Testing **PROJECT**

Continued from Page

Today we tested our robot, and had profound success. With carefully placed stars, we were able to easily lift 7 stars over the fence. Of course, with our old catapult claw, we can't grab anywhere near 7 stars. Next meeting, we hope to widen our claw to be able to hold a number of stars closer to 7 to maximize our effectiveness.

We believe the rubber band system on our lift will give us an advantage over other teams, as ours uses all of the force available for lifting, while other teams aren't. We also plan to widen the claw for the next competition to be more competitive.





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SIGNATURE Cameron L

DATE 1/14/2017

DISCLOSED TO AND UNDERSTOOD BY Michael Ryan

DATE 1/7/17

PROPRIETARY INFORMATION

TITLE Ramney Competition Log PROJECT

Continued from Page

Today we had one of our most effective competitions yet. Our robot design has truely proven itself. We had decent matches (when our claw worked) and got all the way to finals. For our first four qualification matches, our IME (integrated motor encoders) on our drive were restarting due to static discharge. This would also restart the IMEs on our claw, making our robot useless. To counter this, we unplugged our drive IMES, since they were so close to the field and shock. This kept our claw working, however we could no longer use our drive encoders.

Despite those issues, we still had a relatively successful day. We won the think award for our claw and LCD, and made it to ~~finals~~, getting knocked out by 3815J and their alliance. Since the next competition is in only a week, we're not left a large ~~amount~~ of time to complete the changes we'd like, so we will need to work fast. Here is the list of changes we hope to make:

- Speed up lift: Our lift is too powerful, trade the strength for speed
- Make claw lower: Make lifting easier
- Replace drive IMES with opticals: To fix shock issue
- Make claw recovery controls: Just incase we get shocked, we're not disabled
- Add fence hitting bar: To knock stars off the fence effortlessly
- Clip wires and improve lengths: To prevent any unplugging

Continued to Page

SIGNATURE Cameron L DATE 1/7/17

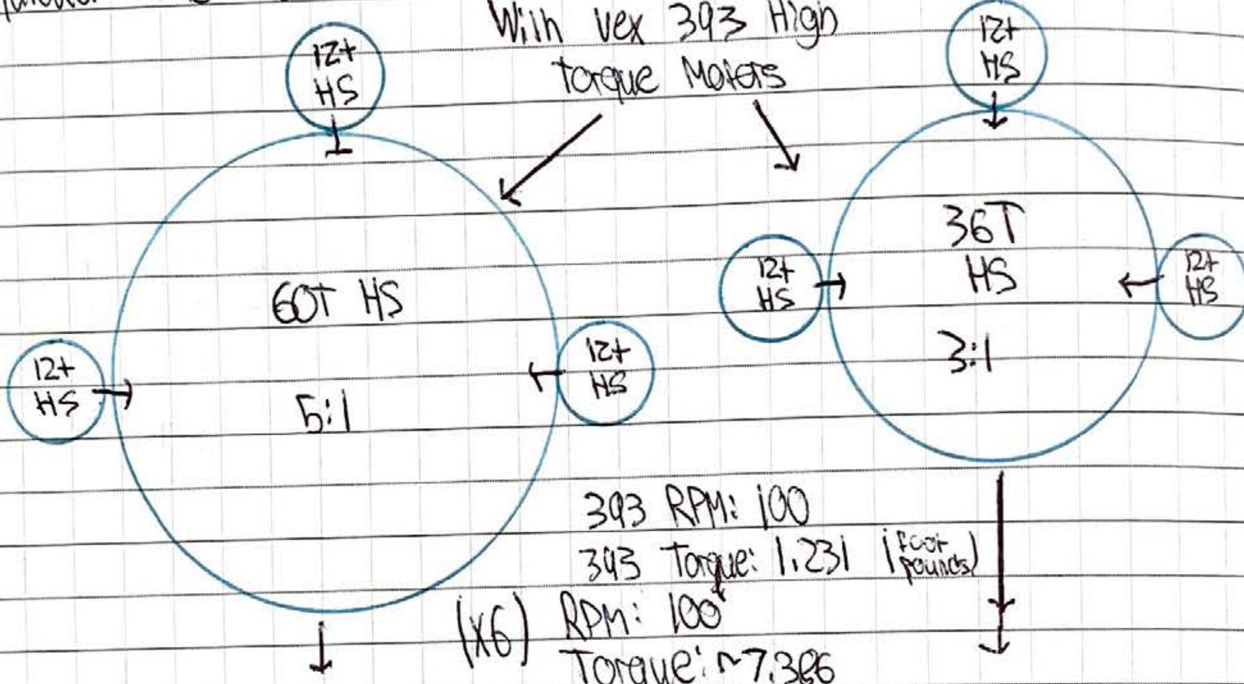
DISCLOSED TO AND UNDERSTOOD BY Michael Ngo DATE 1/12/17

PROPRIETARY INFORMATION

TITLE [BL # 35] Lift increase PROJECT

Continued from Page

Today we changed our lift speed to be much faster. We were able to lift 8+ stars, but in practice we only ever got 4-5 in our claw. To get more out of our lift, we switched the ratio from 5:1 to 3:1. This should let us still lift plenty of objects, but now do it much quicker and score them further into the other side.



RPM: 20
Torque: 36.93 foot pounds

RPM: 33.334
Torque: 22.158 foot pounds

Output Torque decrease: ~~60%~~ 40%
Output Speed Increase: ~~600%~~ 40%

So altheough we lost 40% of our strength, we did testing, and can still lift at least a cube and two stars. This should definetly be sufficient, so the 40% speed increase should be extremely useful.

Continued to Page

SIGNATURE Cameron L DATE 10/10/17

DISCLOSED TO AND UNDERSTOOD BY Michael [illegible] DATE 1/12/17

PROPRIETARY INFORMATION

TITLE High Point Competition Log **PROJECT**

Continued from Page

In terms of personal success, today's tournament was by far our best, even though it doesn't look like it based on our results, and the fact it's the first tournament we didn't win an award. At previous events, we've been generally successful but depended heavily on other teams and couldn't carry our own weight. Today was different.

For the first half of the tournament, we were the first seat team with a record of 3-0 with 12 AP and a decent SP count. Our fourth match we had a hiccup where we were playing for SP, and lost focus the last few seconds, not noticing the other team dumping 4-5 stars last second, tipping the balance. We ended up losing by two points. From that match on and for future tournaments, we'll be much more careful and leave/left more padding when playing SP.

At the begining of the tournament, we were having issues with our IMEs and static, pausing for ~5 seconds every time they were shocked. This happened very frequently, and we knew it had to be fixed, so we replaced the IMEs with quadrature encoders, which aren't susceptable to shock. Although it took some reprogramming and wiring, it was worth it, as we didn't crash again the whole day.

At the end of the day, we ended up as the 6th seat, with a W-L-T of 4-2. We were picked by the second seat, 4610X in semi finals. Next competition, we hope to have improved our claw for easier pickup, and increased our drive speed to be more competitive. We'll also be sure to be careful about our SP.

Continued to Page

SIGNATURE Cameron L

DATE 1/14/17

DISCLOSED TO AND UNDERSTOOD BY Michael Myers

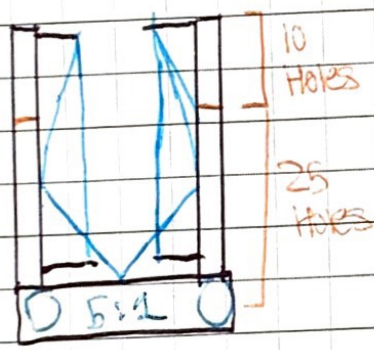
DATE 1/28/17

PROPRIETARY INFORMATION

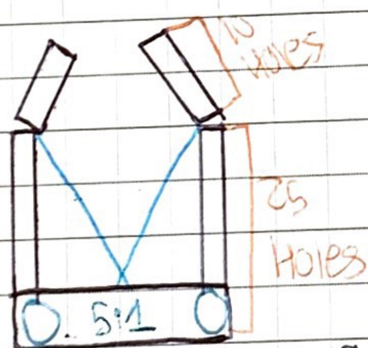
TITLE [BL#36] Claw shape Change PROJECT

Continued from Page

Today we changed the shape of our claw to make picking speeds faster and to help prevent dropping stars; an issue we faced frequently at High Point. Instead of a standoff claw design, we decided to make an angled end claw. Unlike a claw like our old one with standoffs, an angled claw easily slips into groups of stars, reducing the time it takes to pick up much quicker. Also, the angled claw closes much more, greatly reducing the chance of dropping a large group of stars.



Since we're short on time, we decided to cut 10 holes off the end of our current claw, then re-attach the metal to the end with 45° gussets. This will produce the desired effect, without creating any useless pieces of metal.



= Elastics
= Gears

Now, while keeping the same hold capacity as our old claw, we were able to quickly and effectively transform the claw into a much easier to use claw. Also, the changed shape makes it possible to add a much improved rubber band system, which uses less bands and should drop less. Now, we need to speed up our drive, and we should be in a much better place for this comp than the last.

Continued to Page

SIGNATURE Cameron L

DATE 11/17/17

DISCLOSED TO AND UNDERSTOOD BY Michael Nguyen

DATE 11/28/17

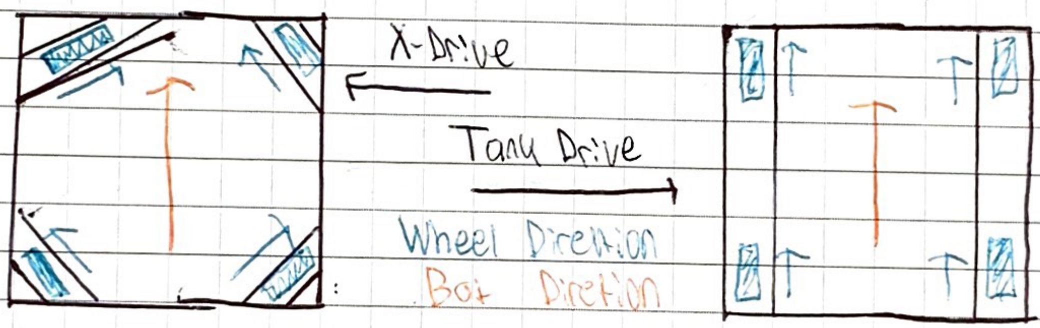
PROPRIETARY INFORMATION

TITLE [BL #37] Drive Redesign PROJECT

Continued from Page

At the last competition, our drive was very slow compared to others, and to keep up, we knew our drive needed a revamp. We decided to drop the long beloved X-drive for a more standard tank drive. The strafing ability of X-drives is nice, but when going forward, you're not putting all of the force possible into the forward direction.

Driving forward with a...



As you can see, when driving forward with an X-drive, the wheels aren't turning in the direction of movement. Because of this, there are extra forces the wheels must endure, slowing the bots speed, despite the native ratio of $1:\sqrt{2}$. With a tank drive, all force is spent going in the direction you want to move, wasting less force, and therefore allowing for higher speed ratios. For our design we decided to direct drive with speed motors, which compared to torque motors, is a ratio of 1:1.6. After testing, the new drive is significantly faster, and should help our overall scoring speed, as we no longer will waste time with our slow drive. Hopefully, the changes we've made this week will reflect heavily in our preformance this weekend.

Continued to Page

SIGNATURE Cameron L | DATE 10/19/17

DISCLOSED TO AND UNDERSTOOD BY Michael Nyon | DATE 1/28/17

PROPRIETARY INFORMATION

______ - 76

BOOK PAGE

TITLE Sparta Competition Log **PROJECT**

Continued from Page

Today we had our best competition this year. Undefeated in qualifications and second seat after 7405M, this is the highest we have ever been in qualifications. 7405M picked us as an alliance partner, with 4610X as the third pick. We later went on to win the tournament. We also finished 3rd in robot skills with a score of 41, our highest score yet.

Not only did we have a successful day in terms of wins, our robot performed extremely reliably. Unlike previous competitions, the robot didn't have any mechanical breakdowns. In finals, the claw began to act up, due to a sensor giving false readings in our claw. We think it might have to do with how our robot hits the claw on the floor sometimes when bringing the lift down too fast, so we hope to prevent this for the future.

We were down two members at this competition, our two scouts, so when nearing selections things became slightly chaotic. We weren't sure who was very reliable, and with no intel, we were panicking to figure out our picks. Luckily, we finished 2nd and were picked by the 1st seat alliance, but this acted as a great example of what can happen with improper scouting.

For the next competitions, we're beginning preparation for states. Our robot is at a good place mechanically, but could use some work on autonomous function. AP are huge this year, so having a good auton could be the difference of 1st and 2nd pick, just like it was at this competition. At states the competition will be tough, so it's important to secure any upper hand we can.

Today also marks the day my trusty notebook pen finally ran out of ink. it was a good 75 pages. RIP Fred.

Continued to Page

SIGNATURE Cameron L

DATE 1/21/2018

DISCLOSED TO AND UNDERSTOOD BY Michael Ryan

DATE 1/28/18

PROPRIETARY INFORMATION

TITLE Lift Motor Comparison

PROJECT

Continued from Page

After reviewing videos from yesterday's competition, we noticed the top team, 7405M, was only running four motors on their lift, yet had comparable speeds to our 6 motor lift. Intrigued by this, we decided to figure out the stall torque and RPM of different motor combinations, internally geared for torque and speed, at ratios of 1:1 (direct), 3:1, and 5:1.

Motor Combo Speeds & Forces with ratios

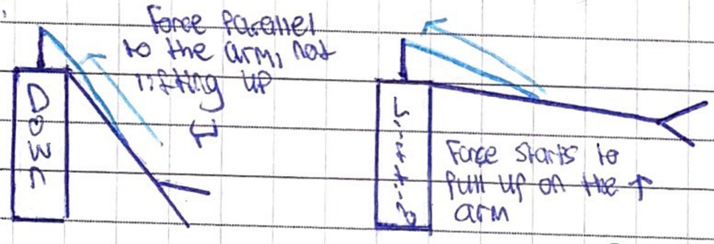
	Torque RPM	Torque N*m	Speed RPM	Speed N*m
Direct (1 motor)	100	1.67	160	1.04
Direct (4 motor)	100	6.68	160	4.16
Direct (6 motor)	100	10.02	160	6.24
5:1 (1 motor)	20	8.35	32	5.2
5:1 (4 motor)	20	33.4	32	20.8
5:1 (6 motor)	20	50.1	32	31.2
3:1 (1 motor)	33	5.01		
3:1 (4 motor)	33	20.04		
3:1 (6 motor)	33	30.66		

7405M's ratio

← 2616H's ratio

← our ratio

After figuring this out, we were suprised to see that 7405M's motor setup has about the same stall torque as our lift. Also, 6 speed motors at 5:1, which our sister H team uses, was very close. The noteable difference is that in theory, 7405M's lift should be 2/3 the speed of H and our lift. After closer observation, we think we figured out why:



When their lift is down, their rubber bands are almost parallel to their arm. Then, when lifting, the bands become less parallel, and start pulling their arm upwards instead of straight into the axle. This lets them hold more elastics than other teams, giving them comparable speed with two less motors. Hopefully we can create a similar system, freeing up two valuable motors.

SIGNATURE Cameron L

Continued to Page

DATE 1/22/2018

DISCLOSED TO AND UNDERSTOOD BY Michael Nyser

DATE 1/28/17

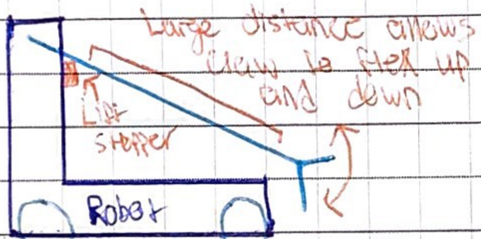
PROPRIETARY INFORMATION

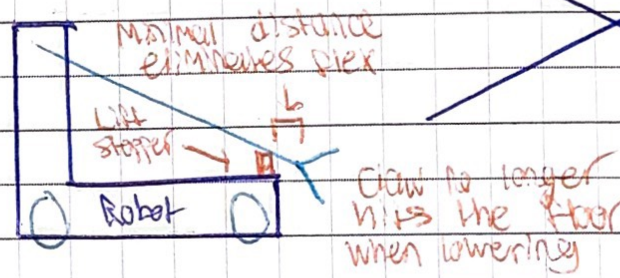
TITLE [BL #38] Fixing claw slamming PROJECT

Continued from Page

In the past, our robot has had a stopper at the top of the lift arm to support it when it was down. The issue with this was that when going fast enough, our claw would slam the sensers into the ground and our gears into our wheels, which was a big problem.

Today, along with some other minor build changes, we set out to fix the problem. To do this, we decided to move our stopper to the bottom of the arm, mounting it to our drive. This completely eliminated the claw hitting the ground, preventing any further damage to our sensors.





We also learned what had gone wrong with our claw at finals during today's meeting. Our senser had an area where the claw encoder wouldn't register any movement. Befuddled, we asked Mr. Griffith, who told us how he experienced similar issues when testing the sensers out. He showed us that you could actually open the sensers up, and use PC cleaner to blow it out. To our suprise, this worked, and the senser worked as good as a brand new one.

We also attached a new quadrature encoder to our drive to replace the IMEs, which were susceptable to static discharge. Now, we're finally able to use encoder readings to measure distance in auton instead of time values. Next meeting we hope to continue our autons for the next comp.

Continued to Page

SIGNATURE Cameron L

DATE 1/24/2018

DISCLOSED TO AND UNDERSTOOD BY [signatures]

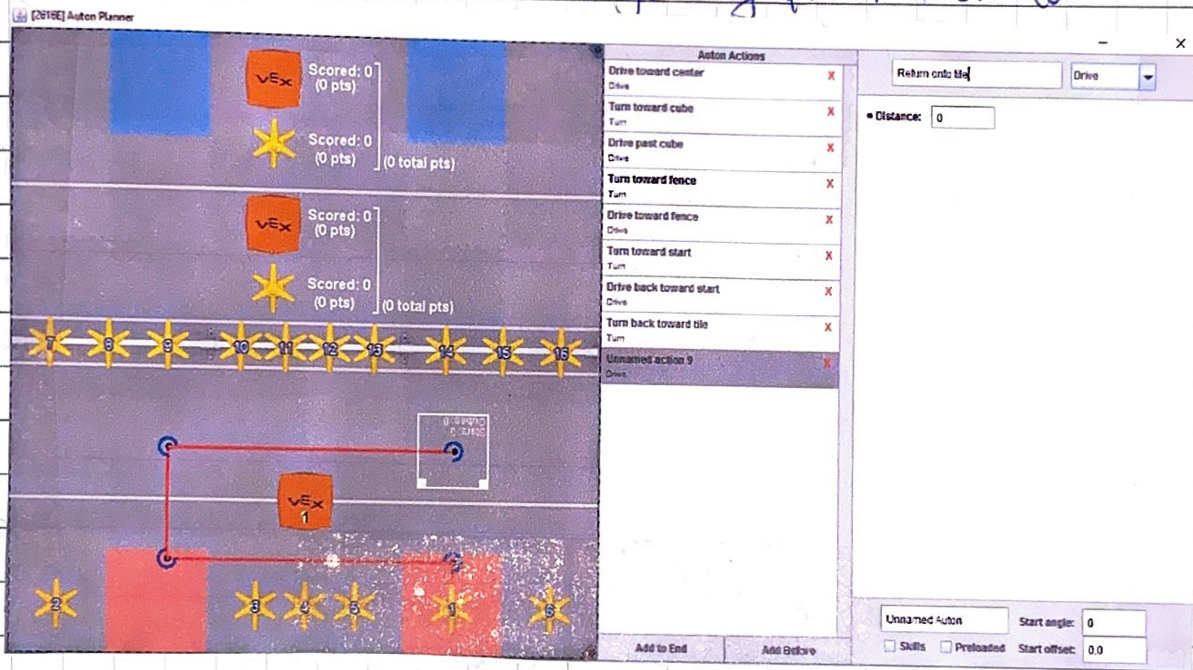
DATE 1/28/17

PROPRIETARY INFORMATION

TITLE Auton Planner Program **PROJECT**

Continued from Page

Even with the best programmers, making autons isn't always easy or quick. Programmers are either forced to sit and do a large number of calculations, or make arbitrary choices to get their auton working right and to set the correct distance variables. Also, looking at a block of code, it's extremely difficult to visualize exactly what your robot is doing. With experience in Java, Michael and I decided to take a new approach to the idea, and make it fast, intuitive, and accurate usign a graphical interface.



The program works by splitting an auton into "actions," little segments that do something, like driving the robot or turning. When you create one of these actions, you can directly see what your robot will do on the field image to the left. This eliminates a lot of testing, allowing more time to be spent on actually building your autons. While still at a very early stage, we hope that the program will allow us to quickly adapt to other robot's autons, and be able to counter them in a matter of minutes instead of hours. Simply build your auton in the program, then press a button to generate RobotC code.

Continued to Page

SIGNATURE Cameron L

DATE 1/25/2018

DISCLOSED TO AND UNDERSTOOD BY Michael Nguyen

DATE 1/28/17

PROPRIETARY INFORMATION

TITLE [BL #39] Autonomous Function Fixes **PROJECT**

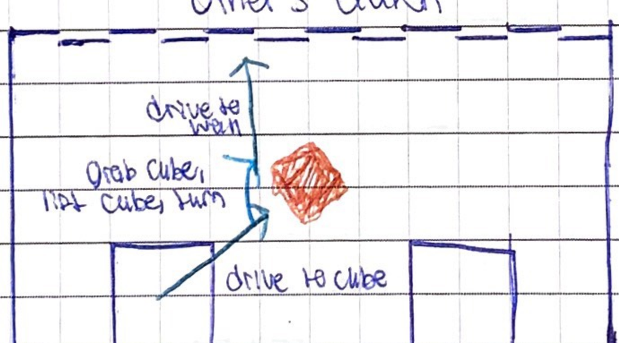
Continued from Page

Our autonomous is broken into many functions, each intended to perform it's own part of our movements. As the robot changes, sometimes these "Modules" need to be tweaked and corrected to work with the new bot. Today we took the time to correct our autonomous methods to work correctly with changes we've made.

Unlike most robots, all of our code is asynchronous. This means we can do multiple things at the same time, like lifting and driving. This gives us the upper hand in terms of speed, because we don't need to everything one thing at a time.

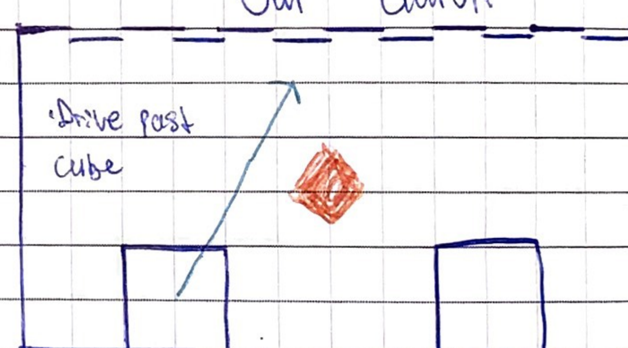
Also, in terms of speed, we decided to make our auton a little different than other teams. Instead of driving to the cube, picking it up, lifting, turning, driving to the wall, then lifting, we simply drive past it backwards, then grab it and throw it. Hopefully, this will beat out other teams autons, possibly jamming them up.

Other's auton



• Multiple time consuming moves

Our auton



• One quick fluid movement

Continued to Page

SIGNATURE Cameron L

DATE 1/26/2018

DISCLOSED TO AND UNDERSTOOD BY Michael Ryan

DATE 1/28/17

PROPRIETARY INFORMATION

TITLE BCIT Competition Log PROJECT

Continued from Page

Today the team had another succesful tournament. We placed second in skills, total score of 56, with 15 programming and 41 drivers. We placed ~~second~~ seventh in qualifiers with a record of 5-1, the match we lost we had a motor failure due to stripped internal gearing, eventually resulting in a stall out of the drive. We were picked by 2616H, the second seed, with a third of 2616P. We later went on to win finals.

Today our autonomous planner proved itself, helping us quickly make a complimentary auton to our finals partner H team. We found a few little bugs that need to be ironed out, but the overall process of auton building was sped up significantly.

Our biggest bottleneck of this competition was our drive. At one point we had internal gearing completely strip, and later in finals we occasionally stalled out. We did, however, compete five matches in a row in finals, pushing our drive hard. We had many pushing matches over the fence, which didn't help the situation either. We hope to possibly link our front and back wheels together so if one lifts off the ground, both drive motors still help.

Other than the possible drive changes, our robot has performed very well, and we plan to spend most of this week building a powerful programming skills and making more use of the time available in autonomous.

Continued to Page

SIGNATURE Cameron | DATE 1/28/2017

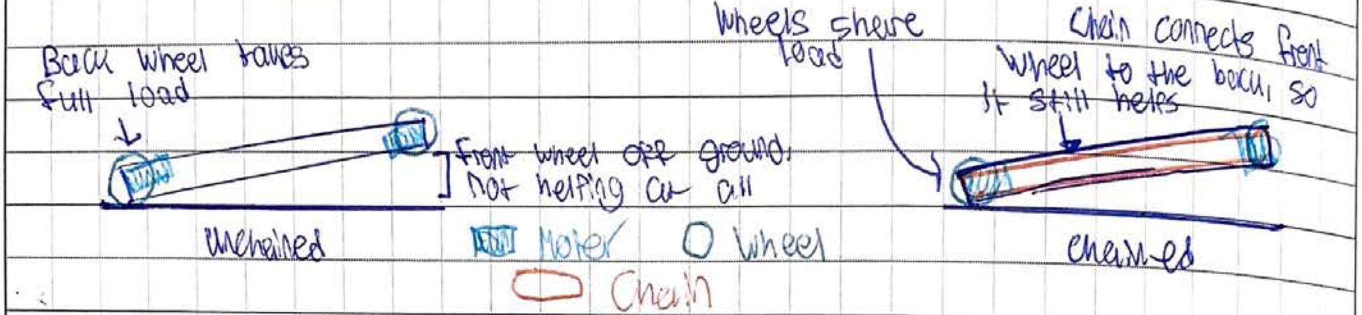
DISCLOSED TO AND UNDERSTOOD BY [illegible] | DATE 2/5/17

PROPRIETARY INFORMATION

TITLE [BL #40] Chaining Drive ~~together~~ **PROJECT**

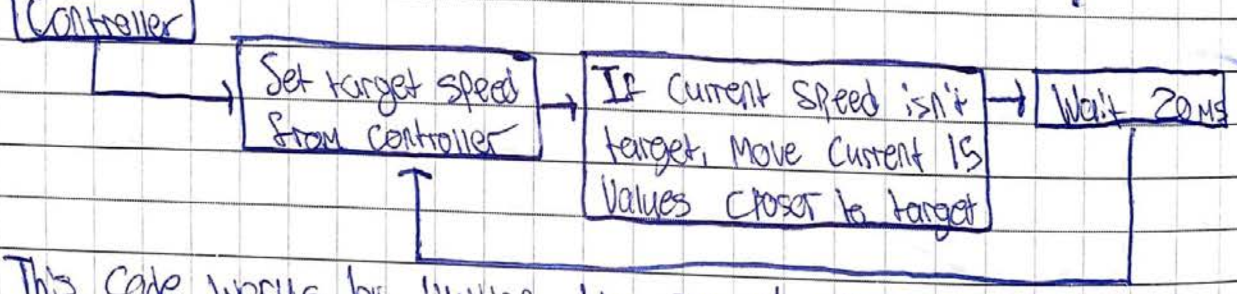
Continued from Page

At the last competition, we had an issue where our drive ~~encoder~~ motors would occasionally have their internal gearing strip, causing a stall out. We also occasionally had our drive motors overheat after a match or two. To combat this, we decided to chain the drive motors together and implement slew rate code.



Chaining the front and back wheels together allows both motors to continue being used even if one lifts off the ground. When fighting over the wall a set of wheels will typically lift off the ground, so chaining the wheels gives us a strength advantage over teams who have independent wheels. Chaining together also helps distribute stress when any sudden shock is applied to the system, hopefully helping reduce stripping.

We also created a ~~loop~~ in code to reduce sudden changes in speed, another cause of stripping. The code works as follows:



This code works by limiting the allowed rate of change to prevent sudden change. So if the controller goes from 127 to -127, instead of changing immediately, it'll spread over 340ms.

Continued to Page

SIGNATURE Cameron L

DATE 1/31/2017

DISCLOSED TO AND UNDERSTOOD BY [signature]

DATE 2/5/17

PROPRIETARY INFORMATION

TITLE Slew Rate Code PROJECT

Continued from Page

In the previous entry, we mentioned that we developed our own version of slew rate code; code that makes sure we don't change our motor's speed too quickly. In the below examples, only the code for the left drive is shown to save space.

```
int leftDriveSpeed = 0; // The current speed for the left drive
int leftDriveTarget = 0; // The target for the left drive
int slewRate = 15; // The rate of change allowed
```

To start off, we declare variables to save the current drive speed, the target drive speed, and the max rate of change allowed.

```
void driveRaw(int speedFL, int speedBL, int speedFR, int speedBR) {
  leftDriveTarget = speedFL; // Set the left target to the given speed
  rightDriveTarget = speedFR; // Set the right target to the given speed
}
```

Next, we create a method to set the drive targets. This uses the same signature as our old drive method so code in other areas doesn't need to be modified.

```
while (true) { // Continuously run checks
  if (leftDriveSpeed != leftDriveTarget) { // If the left drive isn't at target
    // If the difference is more than slew rate
    if (abs(leftDriveSpeed-leftDriveTarget) < slewRate)
      // Set to target, because adding slew would overshoot
      leftDriveSpeed = leftDriveTarget;
    else
      // Increment by slew rate, accounting for negative speeds
      leftDriveSpeed += (leftDriveSpeed > leftDriveTarget) ? -1 * slewRate : slewRate;
  }
}
```

Finally, within it's own async task, a while loop checks to see if we're at the target drive speed. If not, then the code will increment the drive speed by either 'slewRate' or set the speed to the target if the difference is less than 'slewRate'. This code limits the rate of change to a maximum of 'slewRate' every 20ms, preventing massive changes like 0 to 127, helping protect our drive's internal gearing.

Continued to Page

SIGNATURE Cameron L

DATE 2/1/2017

DISCLOSED TO AND UNDERSTOOD BY [illegible]

DATE 2/5/17

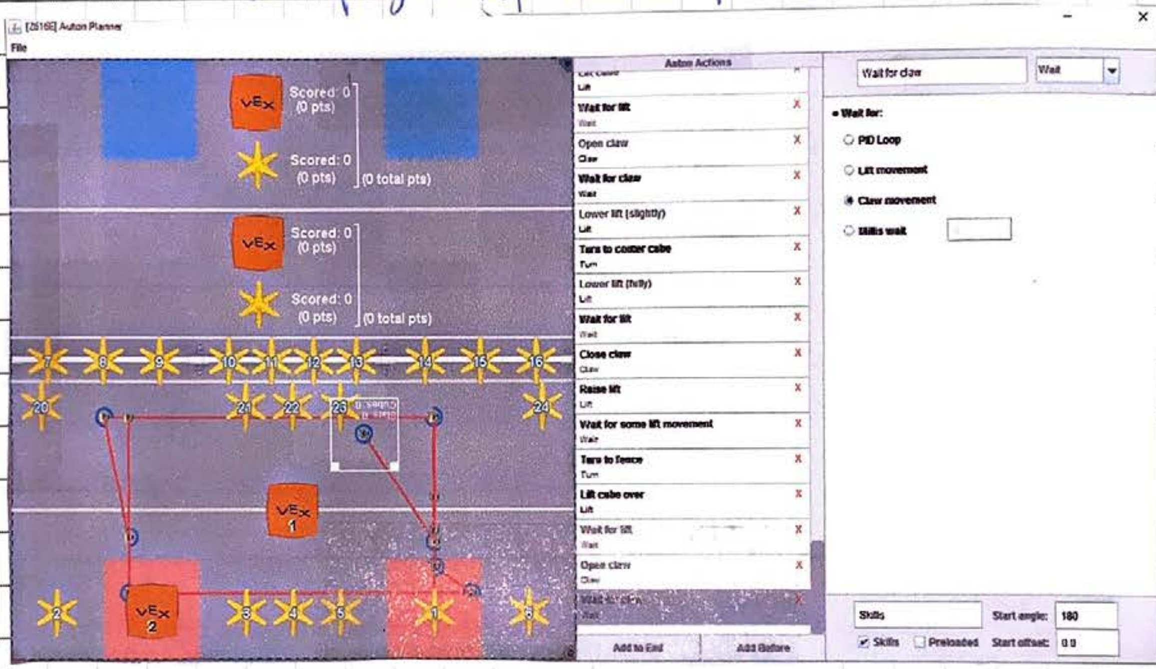
PROPRIETARY INFORMATION

TITLE Auton Planner Update PROJECT

Continued from Page

Clocking in at ~3,800 lines of code, our autonomous planner has become a huge amount of code to make us need to write less code. Receiving a lot of updates since the last mention of it, the planner has beome an integral part of developing autons for our team, and keeping them easy to update. Planning what your robot will do is much more intuitive when you can see what you're doing instead of looking at a block of text

Our programming skills in planner



As you can see, extremely complex autons can be made decently easy to understand. The above auton translates to 95 lines of code. Just looking at the code, it'd be extremely hard to tell what the auton was doing. Not only does the planner make autons easy to understand, it also makes them easy to make. Testing required is extremely reduced since a lot of guessing is taken out, and autons can be made by simply clicking on the field.

Continued to Page

SIGNATURE Cameron L

DATE 2/1/2017

DISCLOSED TO AND UNDERSTOOD BY [signature]

DATE 2/5/17

PROPRIETARY INFORMATION

TITLE Pre-Competition Update PROJECT

Continued from Page Today due to the absence of our mentor, the club didn't meet. To make up for this, we will likely meet tommorow for drivers practice.

The competition this weekend is the second to last tournament before States. With the ~~seco~~ exception of 765, all of the consistently powerful teams are planned to be at the tournament. Because of ~~this,~~ this weekends tournament will give us a good idea of our position in the States. Although we've won finals at the past two tournaments and haven't made many changes, we haven't had a tournament where all of the 'power' schools have been present. There's still a good chance we'll need to improve our robot to keep up, and hopefully it'll show this weekend.

This week we have been practicing driving with a coach to help improve our efficiency. In the past we've only really had a coach at competitions, but we found that we were lacking a consistent way of conveying information, which led to confusion. Now, we decided what the coach should be looking for, and a consistent way of saying it. In the past, the coach would say what to grab to dump, however that was information the driver didn't need too much. Now, the coach warns the driver about time and incoming loads, as well as info about how hard we need to be scoring. This gives the driver the maximum amount of information, letting them act as best as possible in the current situation.

(I really need to stop writing 2016) Continued to Page

SIGNATURE Cameron L

DATE 2/2/2017

DISCLOSED TO AND UNDERSTOOD BY [illegible signature]

DATE 2/5/17

PROPRIETARY INFORMATION

TITLE Millburn High Competition Log PROJECT

Continued from Page

Despite many issues with our drive, today we still made it to the finals match, losing to 7405M, 3815M, and 9227A. We also got our highest skills score yet, achieving a high score of 56. Despite being a high for us, we still only got 3rd for skills. Hopefully over the next few weeks before states, we can greatly improve our skills, possibly securing a spot in worlds by getting into the top 50. It would take a lot of work, but we think it's possible

Today for most of our qualification matches, our drive quickly stalled, leaving us nearly useless. We believe the fault was caused by a match where our anti tips failed to deploy, and instead of the rubber bands coming off our wheel, they wrapped around our wheel and pulled the anti tips tight. We're still not exactly sure what broke, however in the ~4Ss before our drive stalled, we were able to secure wins in semifinals.

With states quickly approaching, we have a lot to get done to help secure a slot for worlds. Our robot has been fast but has frequently had systems break down on it. One of our goals is to try and reduce wear on parts to make sure that we can maintain a fast working bot

Continued to Page

SIGNATURE Cameron L

DATE 2/5/2017

DISCLOSED TO AND UNDERSTOOD BY Michael Ryan

DATE 2/6/17

PROPRIETARY INFORMATION

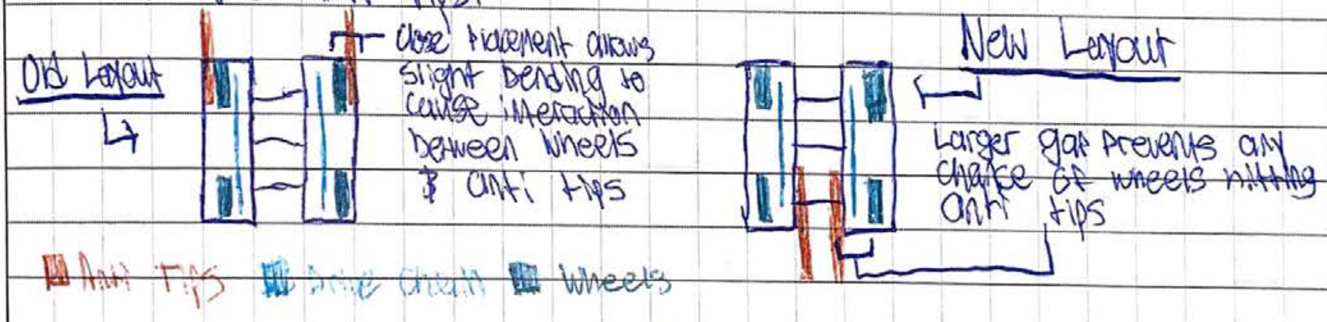
TITLE Fixing Drive Issues PROJECT

Continued from Page

At the last Competition, our drive continuously broke down and became unresponsive. Today we spent a lot of time trying to find the issue, and finally discovered a few issues:

1) Two of our drive Motors would spin, but when put under load, would lock up. This was hard to find, because without deep inspection the Motors appeared to work fine

2) Occasionally, after the failure at the comp, our anti tips would get into our wheels and lock the drive up. When the bands wound up, they must have bent the mount to the anti tips.



To help prevent this from happening again, we moved our drive anti tips from the outside of our bot towards the inner channels of our drive. This greatly increased the distance of the anti tips from our drive wheels, making it impossible for them to interfere with our driving.

Continued to Page

SIGNATURE Cameron L

DATE 2/6/2017

DISCLOSED TO AND UNDERSTOOD BY Michael Nyan

DATE 2/6/17

PROPRIETARY INFORMATION

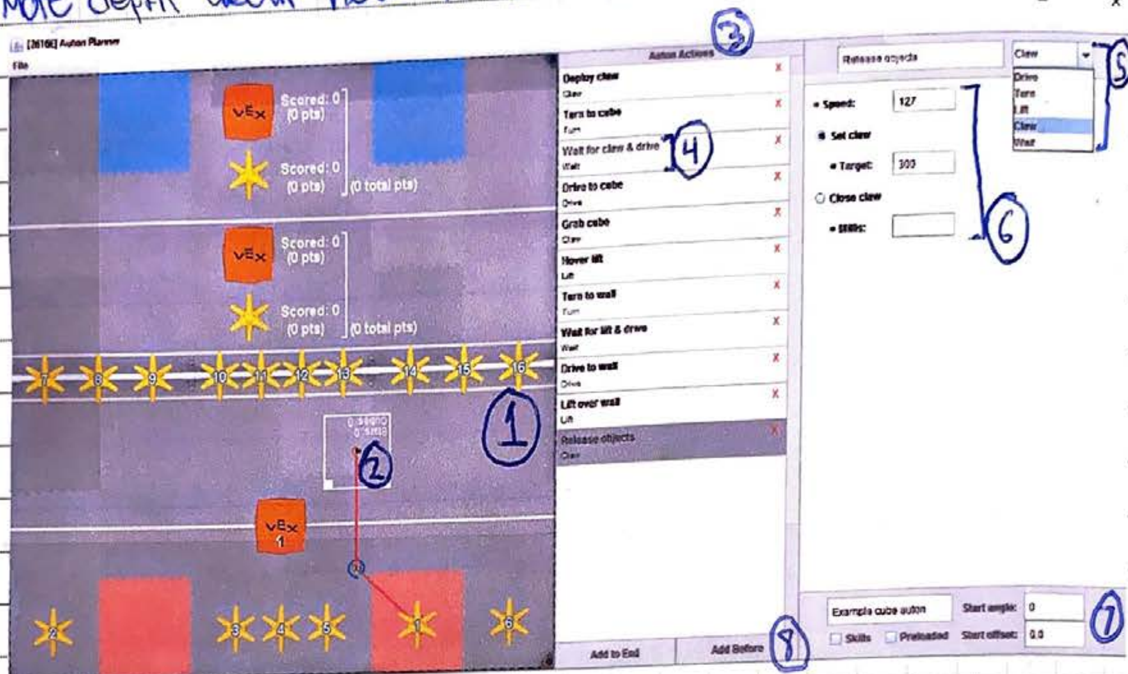
PROJECT

TITLE Auton Planner In Depth

Continued from Page

In the past, we have talked a little bit about the auton planner. Now that it's in a more final state, I hope to go into more depth about how it works.

github.com/Cameronlund4/the-auton-planner



Auton planner is a +- 3000 line program made completely by hand in Java using Swing for GUI. It was designed to be very abstract, so for future games, it will be extremely easy to adapt the planner to be used for that game.

The biggest goal for auton planner was to greatly increase the speed at which our autons could be made. To do this, we made keybinds for every action, so an entire auton can be made without taking your hands from the keyboard. Also, you can click on the field image, and the program will automatically determine the turn angle and distance needed to get to the clicked target. This extremely reduces the amount of time needed to make an auton, as all of the guess work is removed.

Continued to Page 89

SIGNATURE Cameron L

DATE 2/7/2017

DISCLOSED TO AND UNDERSTOOD BY Michael [signature]

DATE 2/7/17

PROPRIETARY INFORMATION

TITLE (continued) **PROJECT**

Continued from Page 88

The Planner works by breaking up the auton into "actions", each responsible for generating 1-2 lines of code. At the moment we have 5 different actions that can be selected seen in (5): Drive, turn, lift, claw, and wait. Each of these actions extend a class, AutonAction, which has abstract methods for everything the planner needs to interact with the action. These methods include 'renderCode(...)', 'renderWithGraphics(...)', and 'renderWithoutGraphics(...)'. Each of these methods take a Robot object as well as some additional information.

Each Action is self contained, and doesn't know anything about the other objects. All it knows is the information given to it in it's input panel, for example (6), where it takes speed, target angle, or a time in millis to close for. These values are then stored within the object until the program is ready to generate the robot code. This system makes it extremely easy to add action types, as actions don't need to communicate with eachother.

```
@Override
public String renderCode(Robot robot) {
    switch (action) {
        case "action1":
            return String.format("setClaw(%d,%d); // " + getWrapper().getActionName(), (int) angleTarget, speed);
        case "action2":
            return String.format("clawClose(%d,%d); // " + getWrapper().getActionName(), millis, speed);
        default:
            return "// !----- Failed to generate claw code here -----!";
    }
}
```

Variables set in (6)

The code to generate the robot code is actually relatively simple. Each action creates it's own renderCode method, the above being for the claw. When the time comes to render, the program creates a new Robot object based on the starting values set in (7). Then, in order, it will go through the list of objects (3), and calls each Action's renderCode(). It passes the first object the new Robot, and the action will modify... →

Continued to Page 90

SIGNATURE Cameron L DATE 2/7/2017

DISCLOSED TO AND UNDERSTOOD BY Michael Ryan DATE 2/7/17

PROPRIETARY INFORMATION

PROJECT

TITLE (continued)

Continued from Page 89

the robot however it needs, for example, move it 1000 ticks forward. Then, it will take the modified robot, and give it to the next action in the list. This way, every action knows where/what state the robot is in when the action takes place, without needing to know every action before it. This makes it easy to change actions before any other given action, without needing to remove every action after. The code simply shifts according to the changes. Each action renders it's line or two of code, appends it to the program, and moves on.

```java
@Override
public Robot renderWithGraphics(Robot robot, Graphics g) {
    int x = robot.getPosX();
    int y = robot.getPosY();
    robot = renderWithoutGraphics(robot);
    Graphics2D g2 = (Graphics2D) g;
    g2.setColor(getColor());
    g2.setStroke(new BasicStroke( width: 3));
    g2.drawLine(x, y, robot.getPosX(), robot.getPosY());
    g2.setColor(Color.BLACK);
    g2.fillOval( x: robot.getPosX() - 4,  y: robot.getPosY() - 4,  width: 8,  height: 8);
    return robot;
}

@Override
public Robot renderWithoutGraphics(Robot robot) {
    robot.moveTicks(distance);
    return robot;
}
```

The graphics for the program work in a very similar manner. The same passing of Robot objects occurs within the graphics render. This way, when you modify an action early on in the program, every other action redraws according to the changes. Everything is drawn to scale on the field image ①. The robot is denoted by a scaled 18"x18" box, with two solid squares representing the robots front ②. The auton is drawn up to the currently selected action, so it's easy to see how the auton progresses. The game objects are also dynamically drawn and stored with the intent of them being moveable and scoreable, however we haven't had time to implement that feature.

Continued to Page

SIGNATURE Cameron L

DATE 2/7/2017

DISCLOSED TO AND UNDERSTOOD BY Michael Nguyen

DATE 2/7/17

Continued from Page

Today we didn't have any build changes to be made. After fixing the drive, our robot is back to peak performance.

Over the season, we've learned a lot about making our autons fast. The biggest factor is to never have the bot sitting still or waiting; you only have so much time. Another major thing we learned was that running asynchronously saves a lot of time. This means doing multiple things in seperate threads instead of doing everything step by step, allowing you to do things like driving and lifting at the same time.

```
// Synchronous program
pidDrivePoint(234 * sideMult); // Turn 45 degrees
// ... code waits for pidDrivePoint to finish
setLift(1000,127); // Bring lift to 1000 on pot
// ... code waits for setLift to finish
setClaw(250,127); // Set claw to open to 250
// ... code waits for setClaw to finish
```

```
// Asynchronous program
pidDrivePoint(234 * sideMult); // Turn 45 degrees
setLift(1000,127); // Bring lift to 1000 on pot
setClaw(250,127); // Set claw to open to 250
waitForPid(); // Wait for driving to finish
waitForLift(); // Wait for lifting to finish
waitForClaw(); // Wait for claw to finish
```

1

2

Program does each task one at a time, waiting for the first task to finish before continuing

1. Program starts lift, claw, and drive at the same time
2. Program waits for all tasks to finish

Most teams we see use synchronous programming, which really lowers their speed in autonomous. The speed we gain from async programming has helped us frequently outrun other team's autons, winning us the auton bonus, which is a big advantage.

With our last competition coming up this weekend, we plan to spend the week practicing driving and building autonomous. This weekend's tournament will have all of the continuously succesful teams, ~~will~~ including 3815, 765, and 7405. Hopefully this tournament will give us a good idea of our status in the state, and we can help create relationships for alliances at states.

Continued to Page

SIGNATURE Cameron L DATE 2/7/2017

DISCLOSED TO AND UNDERSTOOD BY Michael Ryan DATE 2/9/17

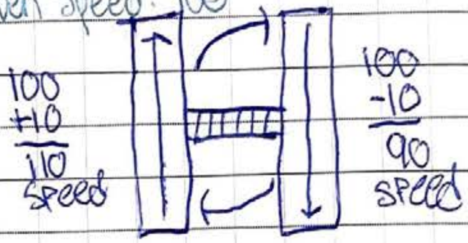
TITLE [BL#42] Gyro Straightening PROJECT

Continued from Page

At today's meeting, we continued work on our auton for this weekend. We've found it to be very reliable, most likely thanks to our straightening code. While it's best to have your robot drive perfectly straight without programmatic help, it's hard to make something perfect enough to do that. Driving at a slight curve will slowly throw your robot off in auton, which can cause you to miss objects and score less points. This is where straightening comes in.

Gyro off 5 degrees: 5 * P(2) = 10
Given speed: 100

```
// Get turning factor, gyro with P term of 2
turningFactor = SensorValue[gyroMain] * 2;
// Limit turning factor
if (turningFactor > 20)
  turningFactor = 20;
if (turningFactor < -20)
  turningFactor = -20;
// Adjust drive speeds
pidDriveLeft += turningFactor;
pidDriveRight -= turningFactor;
```



Slight turn corrects angle offset

This code will take our gyro and multiply the value given, our degrees from 0, or straight. It then multiplies this value by a proportional term, in this case 2, to convert it to drive speed. Next we add/subtract this speed from each drive side, speeding up the correct side to make the drive counteract the incorrect turning. This simple code is extremely useful, and can be the difference between a win or loss in auton. With how important auton is this year, anything that can help is extremely valuable.

Continued to Page

SIGNATURE Cameron C DATE 2/9/2017

DISCLOSED TO AND UNDERSTOOD BY Manuel Nyan DATE 2/11/17

TITLE MCASMET Competition Log PROJECT

Continued from Page

Today, while we won the comp, didn't have our best day. We ended the day 3-2, landing in 19th place. The first match we lost we got propped up on a star and were unable to get off. The second match we lost we had our lift go over it's range when throwing objects over and missing the wall. With the objects still in our claw, we tried to lift back up. Lifting too far unplugged a lift, making our expander trip. This was our last match, and little did we realize our internal gearing was stripped by trying to bring the lift back up with the objects still in our claw.

Not knowing we had broken, we accepted when our sister H team picked us as the first seat alliance. In finals our bot would work for ~45 seconds, but the expander would trip, rendering us and our lift useless. Luckily for us and H, H and 3813M were able to win enough matches to still win the tournament.

For states, we need to be sure that our robot doesn't have any issues like we had today. To help prevent these errors from happening, we plan to change a few things:
- Add some slack to lift wires to make sure they don't unplug
- Add mechanical stopper on lift so it can't go too far
- Clean out lift gears to ensure we don't strip them out as frequently

Continued to Page

SIGNATURE Cameron L DATE 2/11/2017

DISCLOSED TO AND UNDERSTOOD BY Michael Nyan DATE 2/11/17

PROPRIETARY INFORMATION

TITLE 3 weeks before States PROJECT

Continued from Page It's been a long ~~three~~ season for us, starting back in May of 2016. Going from a catapult to our current robot has brought us through about 7 major design iterations. In our 9 competitions, we've qualified for states 7 times, four by tournament champion, two by finalist awards, one by design award. We've been in every eliminations this season (excluding Cape May, due to the double comp) with us getting into finals six out of the nine eliminations we were in. We have won 11 awards, as follows:

- 4x Tournament Champions
- 2x Tournament Finalists
- 2x Think award
- 1x Create award
- 1x Design Award
- 1x Amaze awards

While we've had an extremely successful season, to keep up for States, we need to make some tweaks to our robot and get a lot of practice driving. We split the three weeks until states with goals for each:

Week 1: Build
Remove stop bar, shorten drive, change lift motors, add removed motors to drive

Week 2: Program
Build multiple reliable autons to be compatible with allies

Week 3: Practic driving!

Hopefully, if we stay on track, we'll be ready for States. Continued to Page

SIGNATURE Cameron L
DATE 2/12/2017

DISCLOSED TO AND UNDERSTOOD BY Michael Nyan
DATE 2/12/17

PROPRIETARY INFORMATION

TITLE Removing Stopper with P loop PROJECT

Continued from Page

Today we implemented a p-loop on our lift rather than using a mechanical stop. This has multiple advantages over a mechanical stop, ~~and~~ as we can use a p-loop to dampen our speed when lowering the lift while still stopping at the desired height. A p-loop, is simply a constant multiplied by the difference between the desired and current value. As the current value approaches the target value, the output speed lowers. Before implementing this p-loop we would slam our lift into the mechanical stop, having the potential to bend both our lift arm and c-channel we use to stop the lift. Now this programmatic p-loop eliminates this risk while providing the same functionality. The code for the p-loop was extremely simple to write and implement making it the obvious decision to go with. The entire implementation was only an addition of four lines to our lift code, and is as follows:

```
int speedTemp = speed;
speed = 0 - (abs(startingAngle - currHeight) * LIFT_DAMP_P);
if (speedTemp > speed) // Never be faster than given speed
  speed = speedTemp;
```

Hopefully having this code will reduce the risk of the lift bending while retaining the same functionality

Continued to Page

SIGNATURE [illegible] DATE 2/16/2017

DISCLOSED TO AND UNDERSTOOD BY Cameron L DATE 2/16/2017

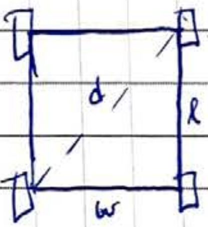
PROPRIETARY INFORMATION

TITLE Shortened Drive to Increase Turn Speed PROJECT

Continued from Page

At today's meeting we shortened the drive to try to increase the speed of our turn. At first we noticed that this caused the robot to tip, a problem we had not previously encountered to a serious extent. Upon lengthening the drive to a point in between the old and new lengths, we discovered that we could turn faster while still not tipping, as we had previously. We measured out our drive to be 11" x 15" as opposed to the previous length of 13.5" x 15". By doing some math we were able to figure out how much we really sped up the turn.

Old drive



$$l^2 + w^2 = d^2$$
$$\sqrt{l^2 + w^2} = d$$
$$\sqrt{13.5^2 + 15^2} = d$$
$$\sqrt{182.25 + 225} = d$$
$$\sqrt{407.25} = d$$
$$d = 20.180 \text{ inches}$$
$$C = \pi d$$
$$C = \pi(20.18)$$
$$\boxed{C = 63.399 \text{ inches}}$$

New drive

$$l^2 + w^2 = d^2$$
$$\sqrt{l^2 + w^2} = d$$
$$\sqrt{11^2 + 15^2} = d$$
$$\sqrt{121 + 225} = d$$
$$\sqrt{346} = d$$
$$d = 18.601 \text{ inches}$$
$$C = \pi d$$
$$C = \pi(18.601)$$
$$\boxed{C = 58.437 \text{ inches}}$$

$$63.399x = 58.437$$
$$x = \frac{58.437}{63.399}$$
$$x = 0.922$$
$$1 - 0.922 = \% \text{ increase}$$
$$\boxed{7.83\%}$$

By decreasing our turn circumference by 7.83% we should have cut down on our turn time by 7.83%. Although it does not seem like a lot, this should give us an advantage when grabbing from the near zone

Continued to Page

SIGNATURE Michael Pagan DATE 2/18/2017

DISCLOSED TO AND UNDERSTOOD BY Cameron L DATE 2/18/2017

TITLE [BL #43] Lift Ratio **PROJECT**

Continued from Page

As we discussed on page 77, you can achieve about the same amount of force with a 4 torque motor lift geared 5:1 as a 6 torque motor lift geared 3:1. Since this setup uses two less motors than the 3:1 gearing, this is much preferred. Since we've been having weekly competitions we haven't had time to change our lift out. Since we have ~2 weeks now until states, we finally had time to change.

1 Motor N*M: 1.67
1 Motor RPM: 100

Old lift

3:1 1 Motor N*M: (1.67)(3): 5.01
3:1 1 Motor RPM: (100)(1/3): 33

3:1 6 Motor N*M: (6)(5.01) 30.66
3:1 6 Motor RPM: 33

New lift

5:1 1 Motor N*M: (1.67)(5): 8.35
5:1 1 Motor RPM: (100)(1/5): 20

5:1 4 Motor N*M: 33.44
5:1 4 Motor RPM: 20

As you can see, 3:1 with 6 motors yields 30.66 N*M. With 5:1 4 motors you can achieve 33.4 N*M of force. This is very close, and while 6 motors 3:1 is technically a lot faster, we've found that in practice the two combinations run at about the same speed.

Continued to Page

SIGNATURE Cameron L
DATE 2/20/17

DISCLOSED TO AND UNDERSTOOD BY [illegible signature]
DATE 3/4/17

PROPRIETARY INFORMATION