ENGINEERING DESIGN DOCUMENT

"It's not about the game, it's about the journey"

FIRST ROBOTICS COMPETITION

Contact Information

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THE ROBOT CHRONOSTAR

CHASSIS

Modeled after the West Coast Chassis design with our own custom chain tensioners.

ARM

We designiged our own custom gear box that will control our arm mechanism.

VISION

We implemented our own custom solution to track reflective tape and program an auto targeting solution.

ABOUT CHRONOSTAR

The Highlanders are proud to introduce our 2020 robot: CHRONOSTAR. We decided to design a robot that we could machine, program, and implement with our team, resources and knowledge. We decided to push our machining capabilities by making our own shooter sideplates: while trying to maintain complex hsm gcode. We decided to achieve a higher overall robot speed at the sacrifice of higher tourque in the drive train. We also decided to go for a short robot that can fit under the trench. Which means we had to combine our sub-systems to accomplish that task.

THE CHASSIS

ABOUT

We designed our 2020 robot using the West Coast Chassis design. Making custom-designed chain tensioners we are able to dynamically adjust how are robot drives in a match. We used a 4 falcon drive train to give us rapid acceleration and the ability to have the power needed in a defense situation. In addition we decided to use 2 omnis on the front of our robot to give us superior agility while moving.

GEAR BOX

We chose to go design our own custom gear box for our 4 falcon motors.

CHAIN TENSIONER

We decided to design the drive train chain with our custom tensioner so we don't struggle from last years problems.

CUSTOM WCC

We went with a West Coast Chassis design, but implemented it our own way.

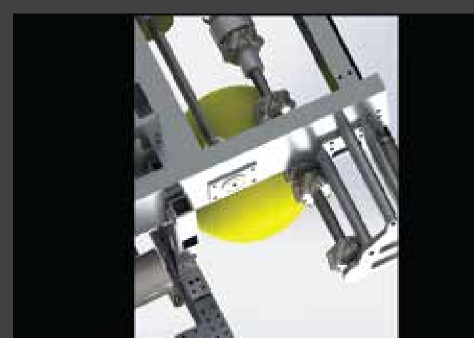
THE ARM AND INTAKE MECHANISM

COUNTER BALANCED

We designed this 3 in one mechanism and counter balanced it with 2 60 lbs gas springs for linearized arm control.

3 MECHANISMS IN 1

To be a trench robot we decided to combine multiple mechanisms, such as our intake and climber into singular comonents.



VECTORED INTAKE

In order to singularize balls and increase our intake range we used 3D printed vectored wheels.

INTAKE IMPROVEMENTS

After our first implementation of this arm we calculated the optimal force to counter balance the arm. We also added a preventitive measure to prevent balls from getting stuck under our robot. We decided to use a lightweight composite material, and machined carbon fiber rod.

CUSTOM

3 IN 1 MECHANISM

VS Code

python

COMPUTER VISION/PROGRAMMING

VISION TRACKING USING REFLECTIVE TAPE

CAMERAS

It was clear that this year we would need to have driver vision, but we had a limit of 4Mbit, so that would require us to manage our FPS/resolution and compression. To accomplish this we are using the JeVois camera and custom code.

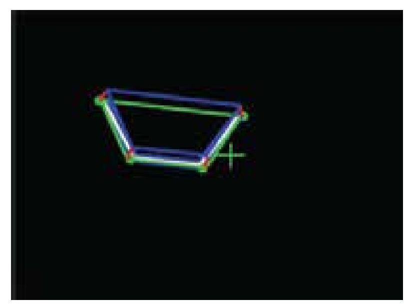
VISION TRACKING

We prioritized the ability to recognize the reflective tape using the JeVois camera and integrated CV code. We wrote custom Python code to detect the targets and calculate distance and angle to send to the RoboRio for an auto-score solution.

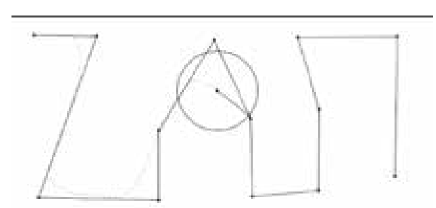
VSCODE/PURE PURSUIT

In order to create a driver assist "auto-score" button, we used a pure pursuit algorithm that creates a "look ahead" point at a configurable distance from the robot. This creates the speed and direction spline the robot needs to move to the target.

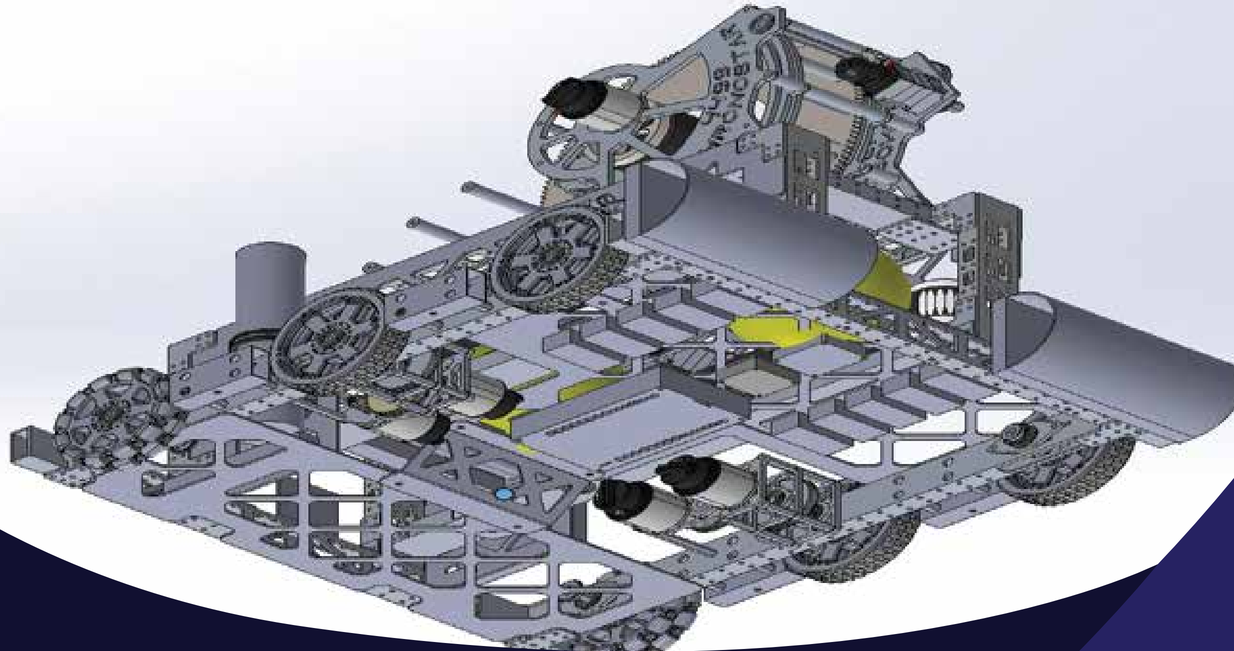
AUTO SCORING



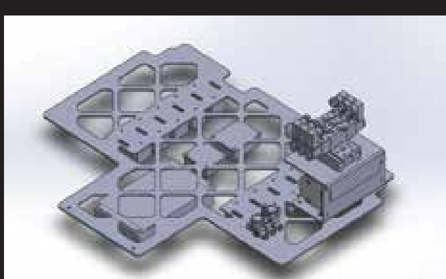
PURE PURSUIT

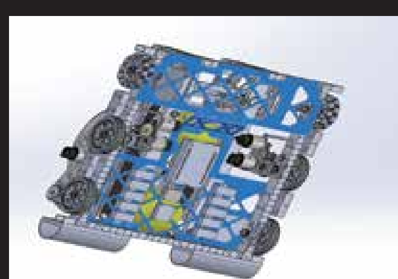


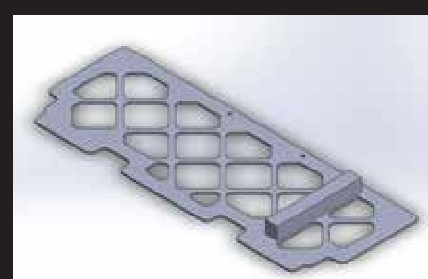
3D PRINTED MOUNTS



ELECTRONICS BOARD DESIGN







MAIN BOARD

We placed our air tanks, pneumatic manifold, solenoids and RSL on the top shelf of our electronics board.

BOTTOM VIEW

We placed our PDP, canifier, VRM, PCM on the bottom of our electronics board.

PLASMA JET

All of our electronics boards were cut out on our team-designed CNC plasma jet.

ABOUT OUR ELECTRONICS

We focused on having our electronics boards completly designed and layed out in SolidWorks. We even made a custom back board with our robot name: GRAVASTAR.

SHOOTER MECHANISM

FLYWHEEL

CAMERA MOUNT

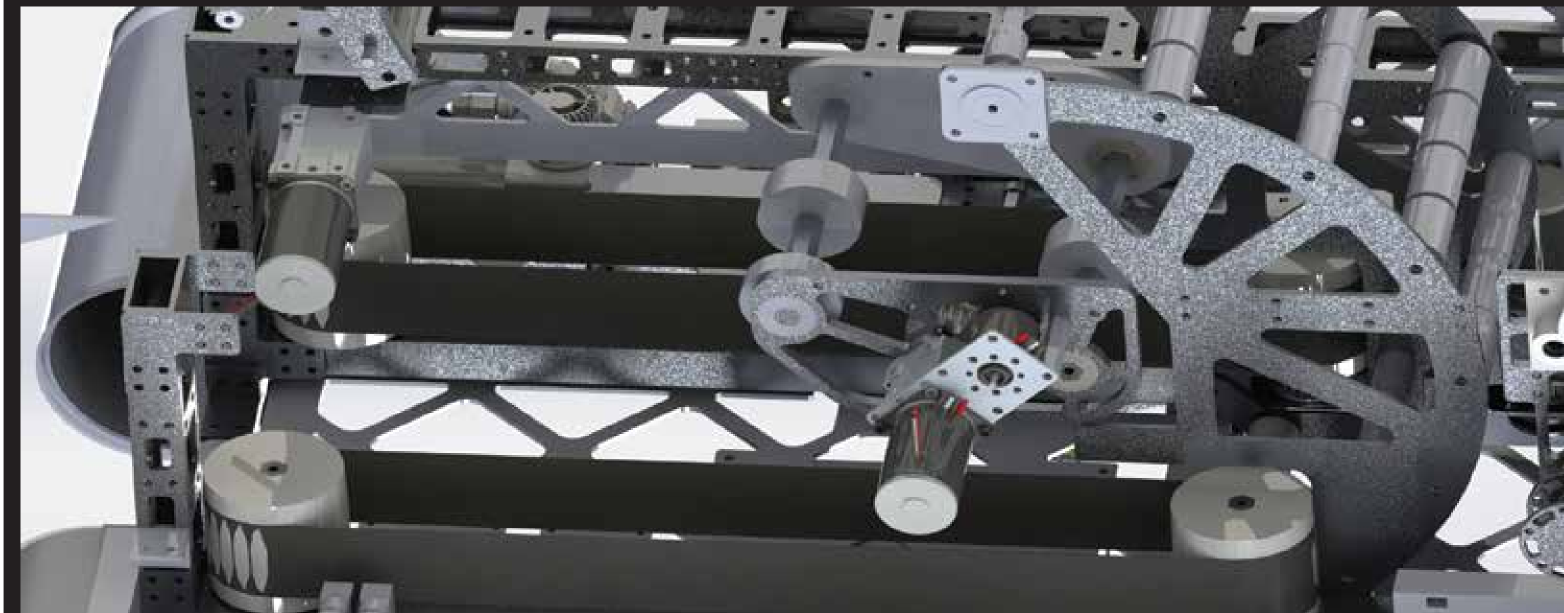
HOW?

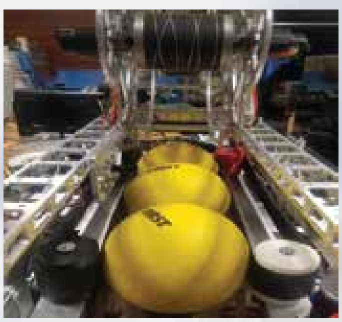
Our shooter started out as a basic prototype, 2 Neo's directly driving a black fairlane that we had from 2017. Using that shooter, our team was able to develop algorithms to track the target using vision, and automatically adjust our shooter velocity to hit our desired target from a multitude of ranges. This shooter however, had a few issues. Without an adjustable hood angle, we had a cap on the ranges that we could shoot from, and the shooter was too underpowered to fire from multiple distances. To fix this our competition shooter is able to adjust both hood exit angle and ball velocity, and with two geared up falcons we're able to hit the target from nearly anywhere on the field. It is able to spin up to its desired velocity in less than a second, and maintain high precision while shooting 5 balls in under two seconds. Too stop our wheels from delaminating, we have voltage and velocity caps on the shooter motors, as well as tied on safety wire across the shooter.

EFFECTIVENESS?

Our shooter can shoot all 5 balls in under 2 seconds.

THE FEEDER MECHANISM





CONVEYOR BELTS

We designed this 3 in one mechanism and counter balanced it with 2 60 lbs gas springs for linearized arm control.

INDEXER

To be a trench robot we decided to combine multiple mechanisms, such as our intake and climber into singular comonents.

CURVED DEISGN

In order to singularize balls and increase our intake range we used 3D printed vectored wheels.

FEEDER MECHANISM

The feeder is the most iterated upon mechanism on our robot. It consists of three sections. First there is the intake, which incorporates a beam brake sensor to detect balls caught in the pass off between the feeder and the belt in order to automatically sort them and feed them back into the robot. Secondly there is the magazine, which uses timed runs to space balls and matches the velocity of a central wheel and outside belt system in order to ensure that balls translate without rolling through the system, stopping lockups and jams in the system. Lastly there is the indexer, which incorporates another beam brake sensor to ensure that we actually do have a ball and only allows balls to be fed to the shooter only when we want to. This system allows us to consistently singularize, and then feed 5 balls to our shooter.

OUTREACH

2/3 ASSISTED
ALUMNI
42% MENTOR
HR

2
FOURTH
OF JULY
PARADES

11
STUDENTS

5000
PEOPLE

STARTED
8 FLL 1 FLL Jr
1 FTC

10 FLL **1 FLL Jr**
MENTORED

IT'S NOT ABOUT THE **GAME**

IT'S ABOUT THE **JOURNEY**

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2 **ROBOT** DISGUISE **DAYS**

GRADUATES

100% Attend **College**

STEM Majors

6 **Youth Summer Camps in** **3** Years

ONE ALUM JUDGED AT
3 REGIONALS AND
3 CHAMPIONSHIPS

3rd YEAR
SUPPORT of
LOCAL STEM EVENTS

THE HIGHLANDERS

7 years @ Championships

2 Regional DEAN'S LIST Finalist

3 Regional Chairman's

2 Rookie All-star

3 Regional Finalists

Galileo Gracious Professionalism

1 WORLD CHAMP Division Win

66 Expo booths &

2 Engineering Inspiration

2 Regional WOODIE FLOWERS

1 Engineering Excellence

2018 World Championship Finalists