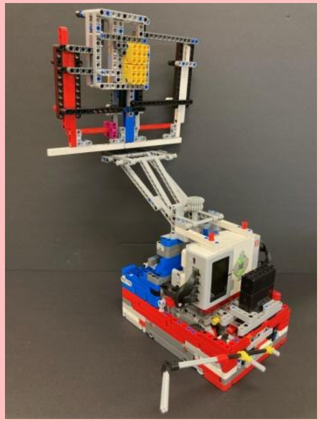
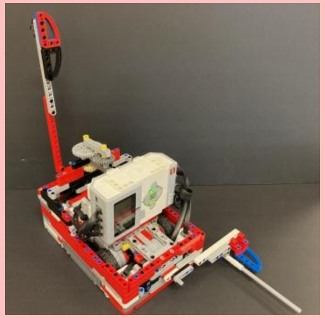
CREATE

Z Forklift, Arm 2, Z Weight, Z Package



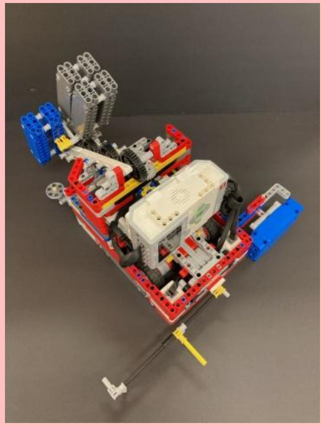
In the first zone, our robot uses these attachments to latch the truck to the bridge and lower both bridge decks and train tracks. Then it delivers the package and uses the forklift to retrieve the blue and green containers and bring them to Home.

Big Fancy Arm, Little Arm



In the second zone, our robot uses these attachments to switch the engine from diesel to electric, lower the cargo plane door and drag its container into the gray circle and push the blue-hinged container to Home.

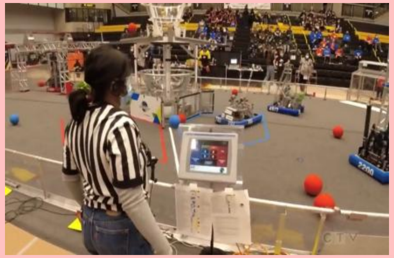
Geary, Arm 1, Z Arm



In the last zone, our robot pushes the hinged blue container to the gray circle, drags the airplane and the truck to their destinations, unloads the cargo ship, separates the food package from the helicopter, pushes the train to the latch at the end of the tracks, balances the cargo on the ship's west deck, and knocks down the yellow accident-avoidance panel.

COMMUNICATE

On March 1, 2022, we were interviewed by *FIRST* Robotics Canada on its weekly *FIRST* Canada Livestream. On the show, we shared our passion for STEM and robotics with enthusiasts around the world.



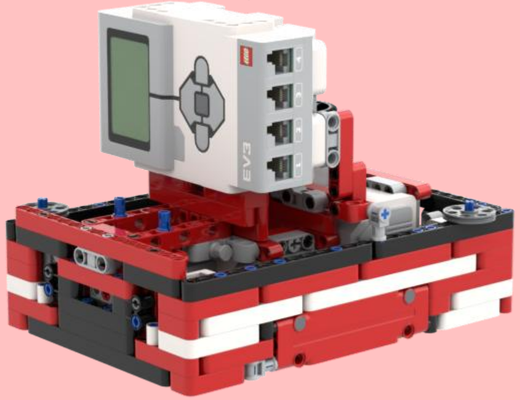
On April 16, 2022, Ctrl-Z Bayview Glen was invited to the *FIRST* Robotics Competition (*FRC*) Provincial Championships held at the Paramount Foods Centre in Mississauga, ON. The event was an opportunity for the *FRC* competitors and fans to recognize Ctrl-Z for having recently won the *FLL* Ontario East Provincial Championship and to send the team off to the Houston *FIRST* Championship. Ctrl-Z demonstrated its robot to an audience of about 800 at the *FRC* Provincials.

On January 18, 2022, we met with *FLL* Team 44851 LEGO Legends. We shared our robot design, and robot presentation. We discussed the robot strategies and ways to improve robot performance.

With our website, we share our approach to robot design, building, and programming with visitors from around the world.

On April 8, 2022, Ctrl-Z presented to 200 attendees from the Bayview Glen Lower School. The students were intrigued by the team members' passion for STEM and FIRST. It was a really great learning experience for both the audience and us.

CTRL-Z



http://ctrlzfll.com

BAYVIEW GLEN

Whole Child. Whole Life. Whole World.

VERITAS VOS LIBERABIT

CARGO CONNECT

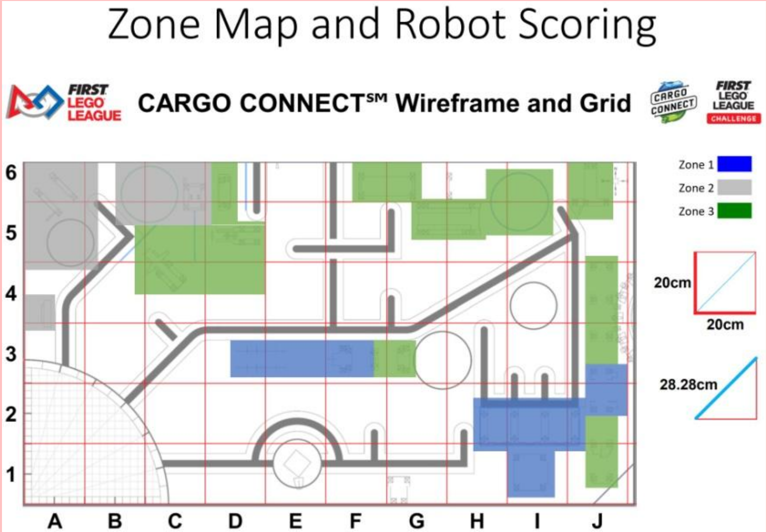
IDENTIFY

High-Level Strategy

In the first few months of our season, our team spent many hours designing, building, and programming our base robot and attachments. While our team strives to create a robot that is as repeatable as possible, we recognize that achieving 100% repeatability of the robot is practically impossible due to varying mat and table conditions. However, with the use of our color sensors, we can minimize the error associated with navigation and mission completion.

Robot and General Strategy

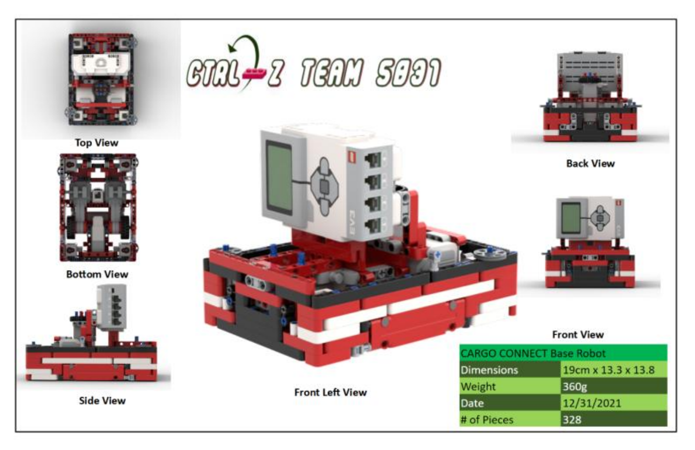
- Maximize points per second (i.e., minimizing time in launch area to complete as many missions as possible, combining missions based on proximity and attachment used (see diagram below)
- Use the printed markings in the launch area to position the robot for launch
- Use reference points on the mat (lines, walls and mission models)
- Using small, compact and efficient attachments
- Follow the wall with guide wheels, when possible, to drive straight
- Follow the lines on the mat to guide our robot to mission models



Ctrl-Z Team #5831 CARGO CONNECT							
Zone		**Points**	**Time in Base Before Mission (sec)**	**Robot Running Time (sec)**	**Total Mission Time (sec)**	**Clock at End of Mission**	**Pts/sec**
Zone 1	Door: Home Delivery	100		55	55	0 Min 55 Sec	1.8
Zone 2	Switch Engine	110	6	14	20	1 Min 15 Sec	5.5
Zone 3	Unload Cargo Ship	260	10	65	75	2 Min 30 Sec	3.5
	Precision tokens, equipment inspection bonus, chicken in	80				2 Min 30 Sec	
Total		**550**	**16**	**134**	**150**	**2 Min 30 Sec**	**3.7**

DESIGN

Robot Design Process



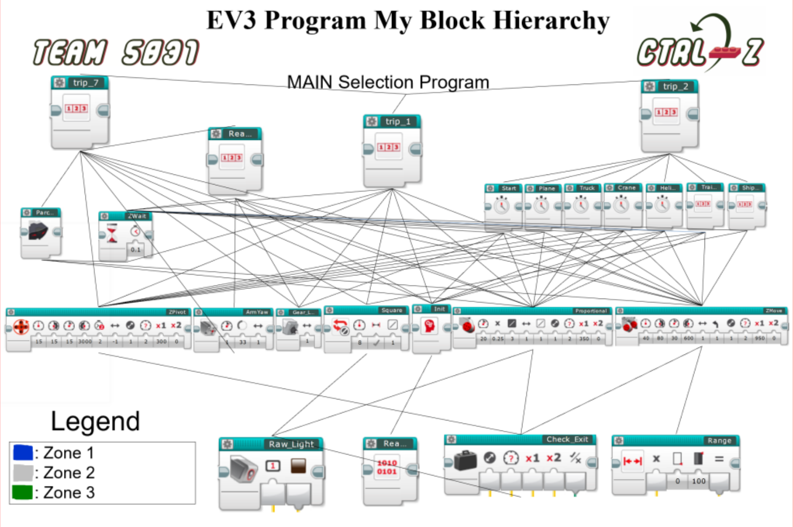
Our robot is very robust and compact with a frame for strength and an easier way to drop in attachments. We use four color sensors, well shielded from ambient light. Our robot has two small trailing wheels at the back of the frame, which are steering neutral and small drive wheels. These small wheels allow for more accurate movements as they decrease the effect of error associated with the drive motor rotation sensors. However, we sacrifice some speed due to our small drive wheels. Our robot also has three guide wheels, on the sides of the robot, to follow the wall.

When designing our base robot, we established criteria at the outset, such as desired footprint, height, balance, drive train, sensors to be used, user interface, etc. to arrive at a working prototype. We also strived to design and build a robust base robot, which features a frame around the chassis to provide structural rigidity as well as means to square up against walls and mission models. When we design attachments, we keep in mind that these attachments need to be robust, easy to install and remove and both passive and multi-purpose whenever possible. From testing the prototype base robot and the attachments, we revised our work to combine and speed up missions and increase repeatability to achieve maximum efficiency.

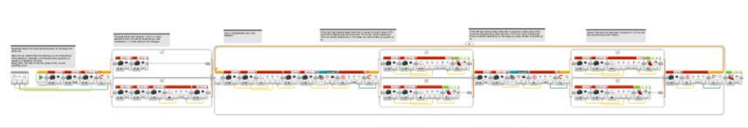
Brainstorm Desired Features for the Robot

- small footprint
- 2 drive motors and 2 attachment motors
- frame for strength, squaring against walls/mission models and shielding ambient light
- 4 color sensors placed at corners of robot
- standardized bay for large motorized attachments
- small drive wheels
- accessible microcontroller and li-ion battery
- steering neutral trailing wheels

ITERATE



In the interest of maximizing programming efficiency, we use subroutines whenever possible. Subroutines are used for typical robot movements, like line following, squaring to a line, error-corrected movements, etc., as well as for entire missions. The use of subroutines allows us to re-use programming code and enjoy the benefits of an efficient mission selection program. The diagram above illustrates the great extent to which Ctrl-Z re-uses programming code.



SquareUp aligns the robot perpendicularly to the edge of a black line.

The Z-move MyBlock is a more accurate move block compared to the standard move block. It has acceleration and deceleration to prevent skidding when the robot starts and stops moving. The MyBlock allows the robot to either move straight or to do an arc turn, based on the input parameters.