PRELIMINARY ROBOT DESIGN AND CONSIDERATIONS

PUERTO RICO

2019

WORLD ROBOT OLYMPIAD

PR-ARC Robotics Team: Techno Inventors Inc.
Puerto Rico
Preliminary Robot Design and Considerations
2018 Development and Build Team

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Competitor and Captain of the PR-ARC Robotics Team: 2019
Doc. Version 1.2

Abstract

This year, PR-ARC Robotics Team assembled a robot to address the 2019 World Robot Olympiad (WRO) in the category of Advanced Robotics Challenge (ARC). The development and build team considered several aspects like: Design, Build, Prototyping, Viability, Functionality and Strategy. By coordinating multiple tasks to construct and integrate mechanisms for each aspect of WRO-ARC Competition, the team has studied all fields of the several aspect to get good reviews on critic, elaborating structures of complex multitasking solutions like the principal robot mechanism. Finalizing with preliminary ideas of 90% of effectivity after the integration.

The robot development process was structured and organized with instructors and mentors focused on STEM fields. On workshop, the robot was considered like a huge challenge that never stopped us. This project had to address the challenge like a complete autonomous machine sorting with logical structures and all of the movements to obtain the highest scoring on the competition. The team never worked with this year's challenge. For that reason, the priority was to complete the project before everything. We compared our robot, components, parts and ideas with other competitions and industrials mechanisms. We worked together so that the development process of the WRO-ARC competition gives positive results.

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Introduction:

The WRO (World Robot Olympiad) ARC (Advanced Robotics Challenge) 2019 generally consists of creating a robot and programming it to be completely autonomous so that it follows a series of instructions that will allow it to accumulate a score with which it will later be evaluated.

Advanced Robotics Challenge:

The Advanced Robotics Challenge (ARC) is our newest category. The games are designed to test older and more experienced students' engineering and programming skills to the limit.

In 2015 and 2016 we ran the Tetra-Stack challenge. The new game for 2019 and 2020 will be the last ARC game.

Advanced Robotics Challenge Characteristics:

- One age group: 17-25 years old.
- Hardware: Robots must be built using MATRIX and TETRIX® building systems only. There are no restrictions about the use and brand of sensors, batteries or electrical motors and servos.
- Controllers: The controller used for the robot must be MyRIO, KNR (MyRIO based) or PRIZM. The main decision maker must be on this controller.
- Software: Control software must be written in LabVIEW from National Instruments™ or any text-based language like C, C++, C #, Robot C, Java or Python.
- Maximum robot size: 34, 5 x 34,5 x 34, 5 cm.
- Team: A team consists of 1 coach and 2 or 3 team members.

A World Robot Olympiad Presentation:

A non-profit Organization:

World Robot Olympiad Association is a non-profit organization. All revenue from sponsorships and fees is invested in support of our mission, which is to promote robotics in STEM education worldwide.

World Robot Olympiad aims to bring together young people all over the world to develop their creativity and problem solving skills. We do that by organizing challenging and educational robotics competitions.

WRO Objectives:

World Robot Olympiad is dedicated to:

- Offer young people the opportunity to expand their horizons through exploration of robots and robotic systems.
- Widen the view of young people and encourage them to be our future scientists, engineers, makers and inventors.
- Help young people acquire 21st century skills like creative thinking, cooperation and communication.
- Help introduce the concept of modern science into educational activities.
- Promote robotics in STEM education worldwide.
- Bring together young people from all over the world to measure their skills and have fun at our annual international final.

WRO History

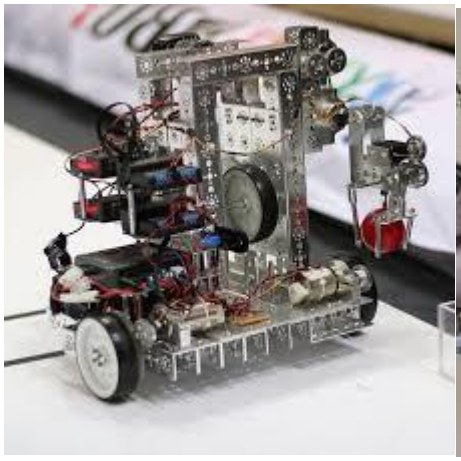
World Robot Olympiad or WRO was founded in 2004. The mission statement of our founders was:

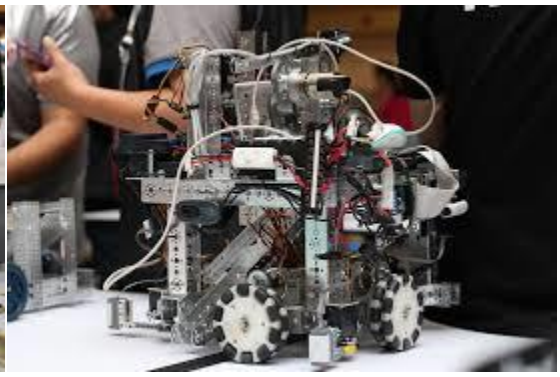
"To bring together young people all over the world to develop their creativity, design and problem solving skills through challenging and educational robot competitions and activities."

It was decided that the annual WRO international final would be hosted by a different country each year. In 2004, the event was hosted by Singapore and 12 countries participated. Only ten years later teams from 48 countries travelled to Sochi in Russia for the international final! Today, the competition that started small in a few Asian countries has expanded to over 65 countries spread over all continents, making WRO a truly global event. Since 2010 World Robot Olympiad Association Ltd. is officially registered as a legal entity with the Accounting and Corporate Regulatory Authority (ACRA) in Singapore.

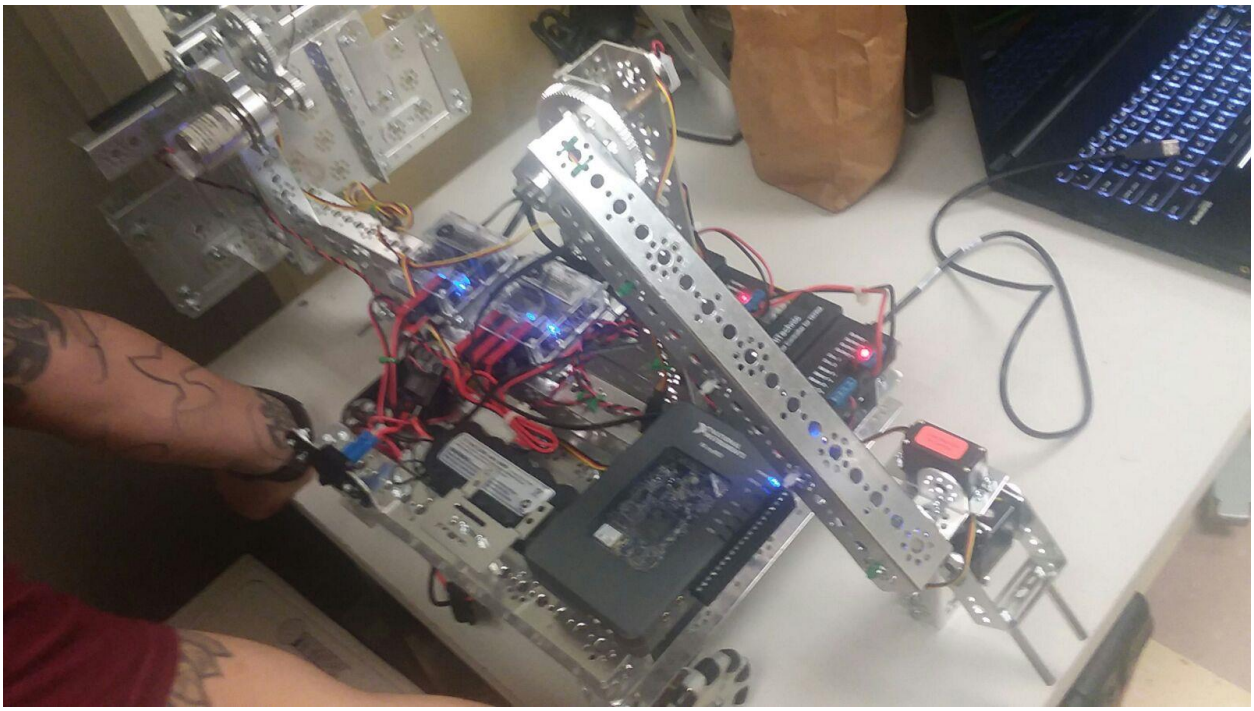
This is WRO-ARC & PR-ARC Robotics Team:

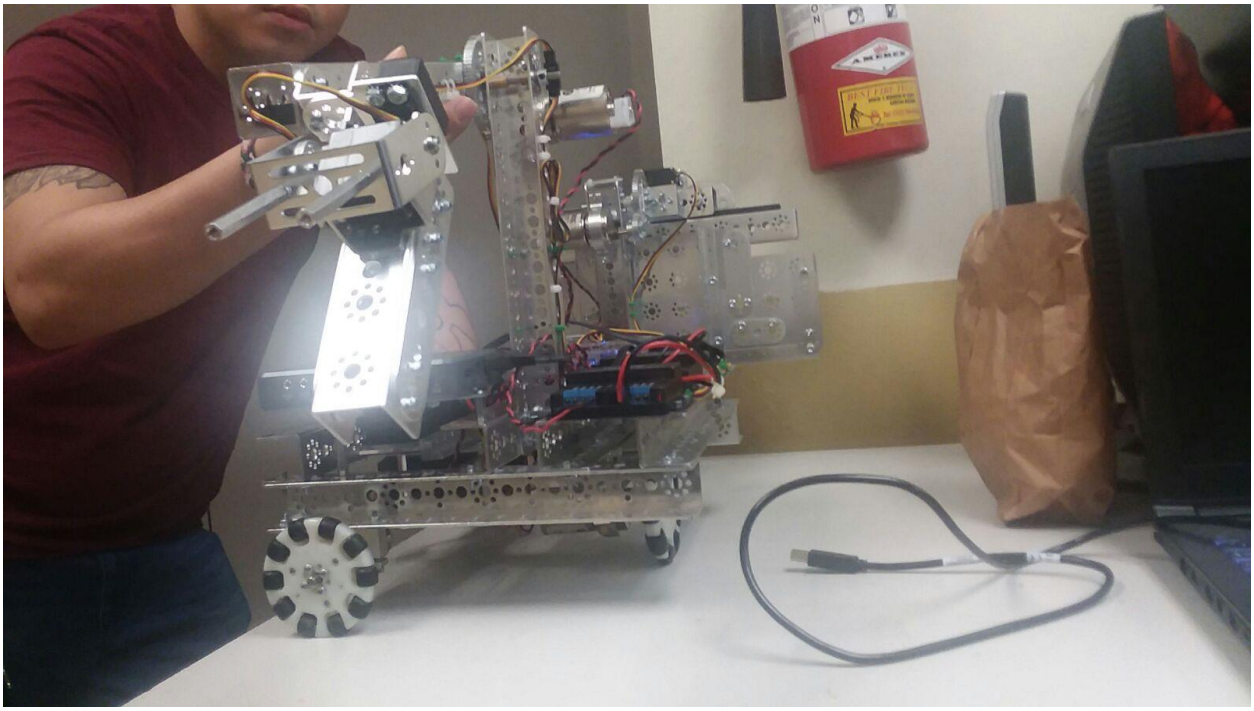
WRO-ARC: Gallery

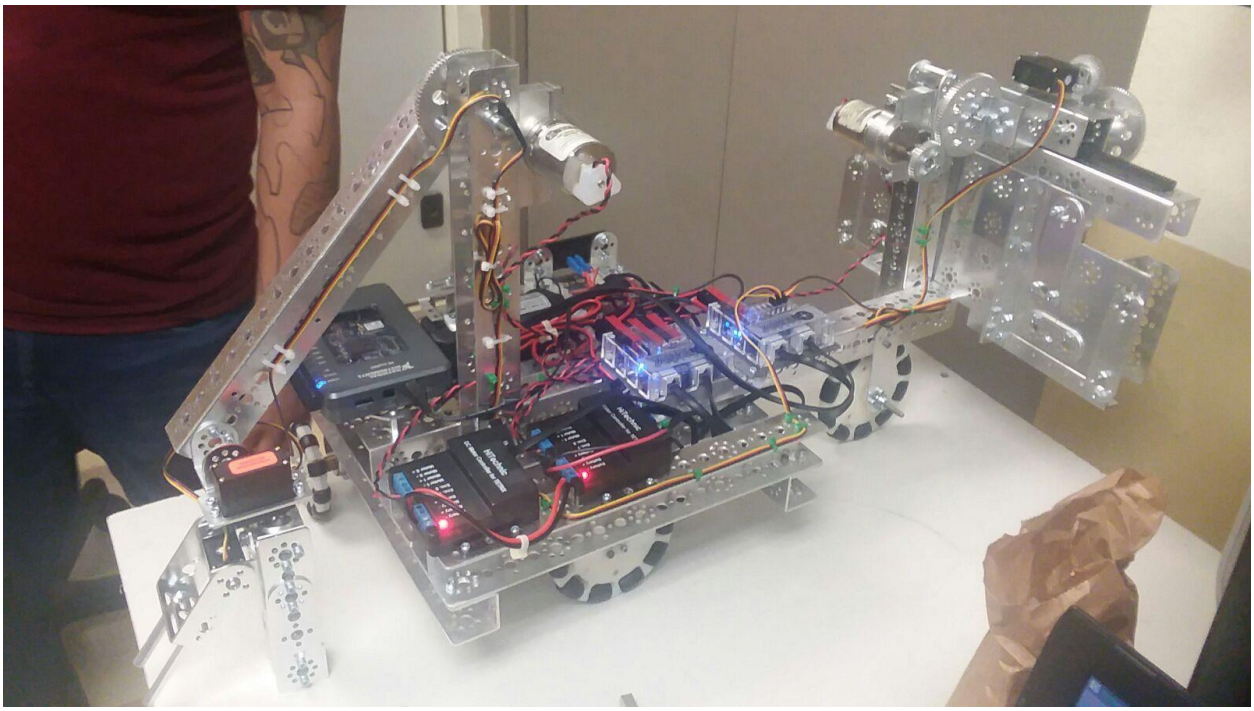


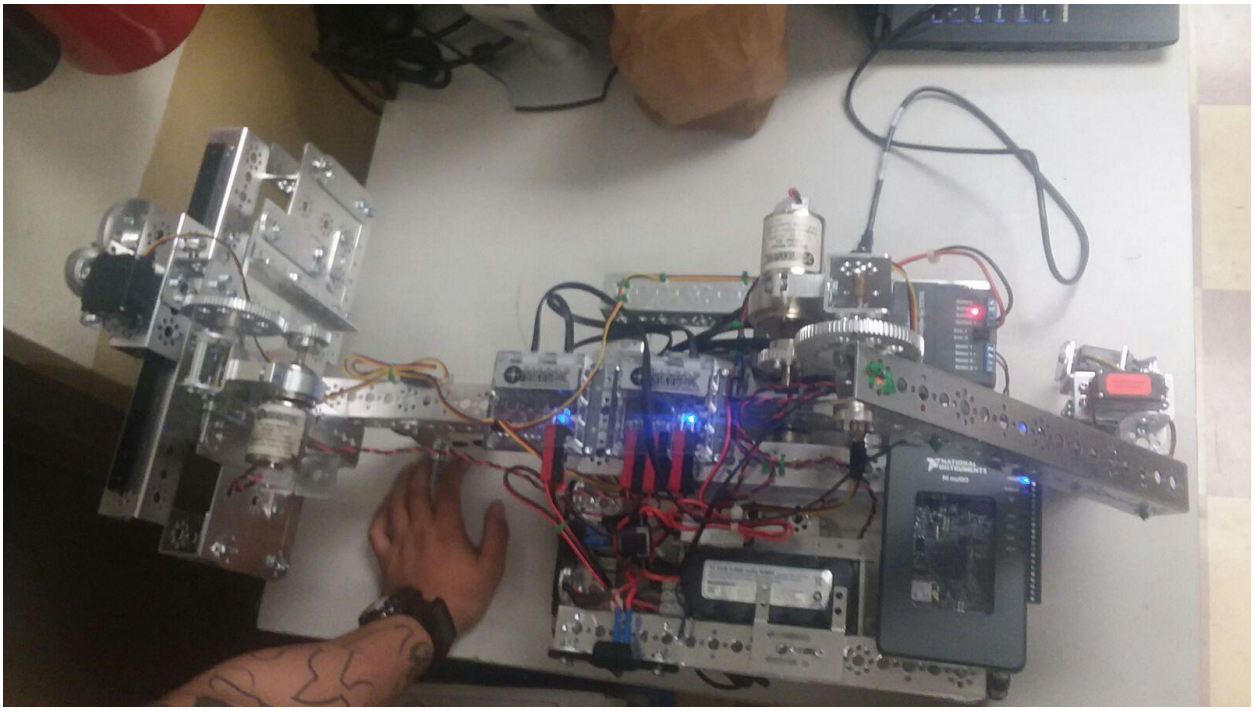


PR-ARC Robotics Team: Gallery









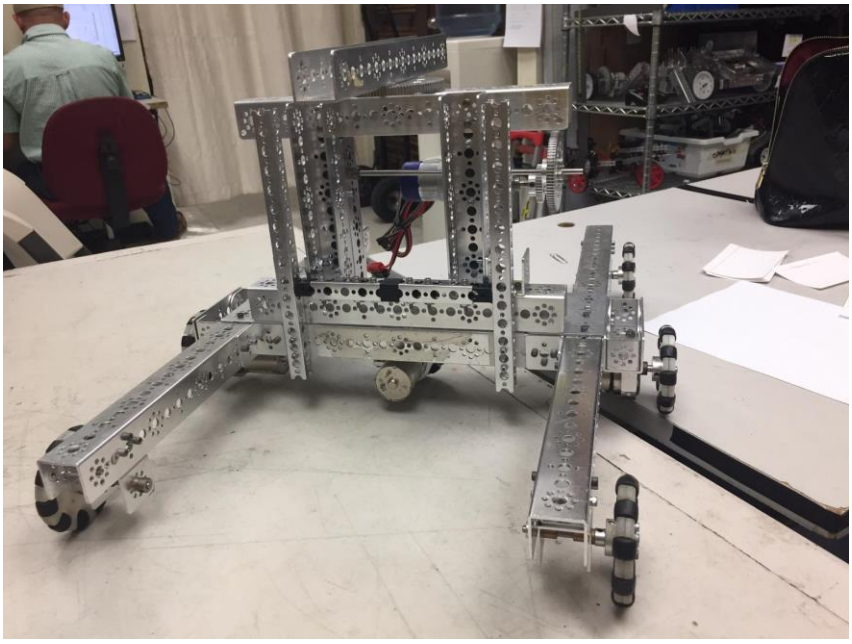
Strategy:

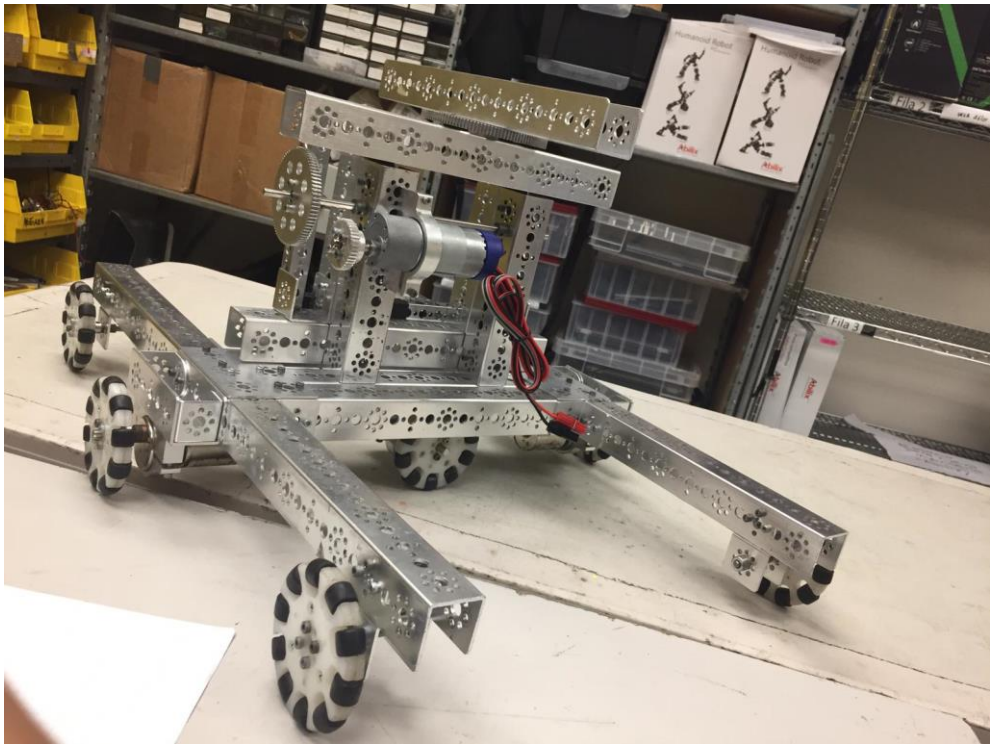
Our logical reasoning led us to identify and devise effective forms of point accumulation, where the priority is to create a gripping mechanism for the purpose of obtaining and accumulating the highest number of points per round in the shortest possible time. In addition we formulate an initial guide with the minimum approximate quantity of the motors, sensors and other requirements for the robot development.

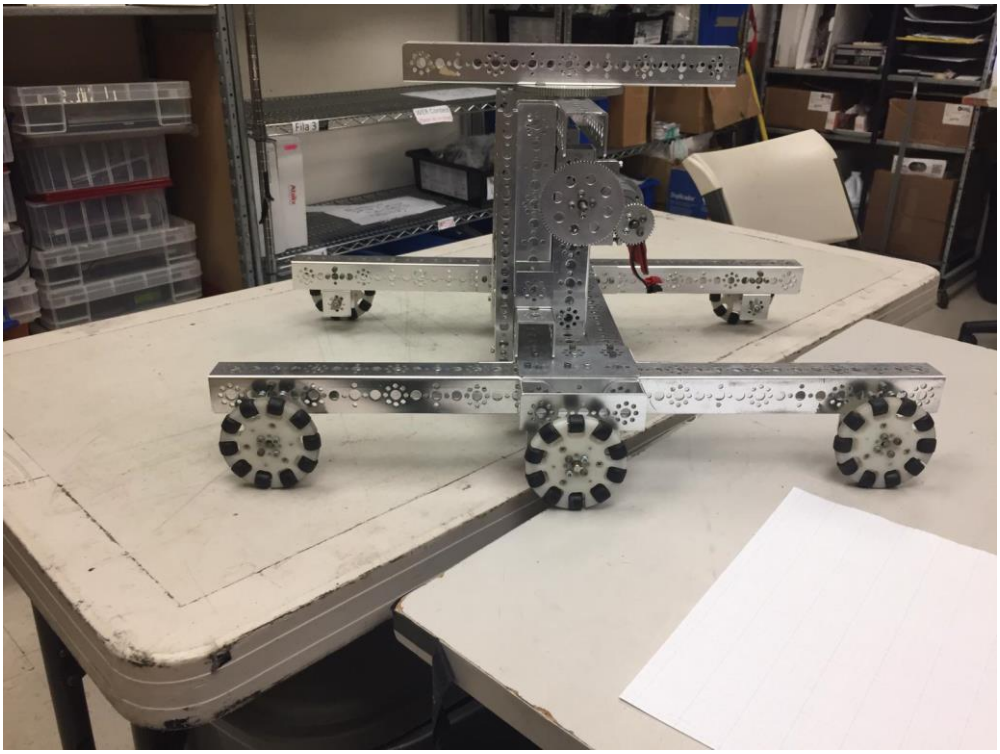
Prototyping:

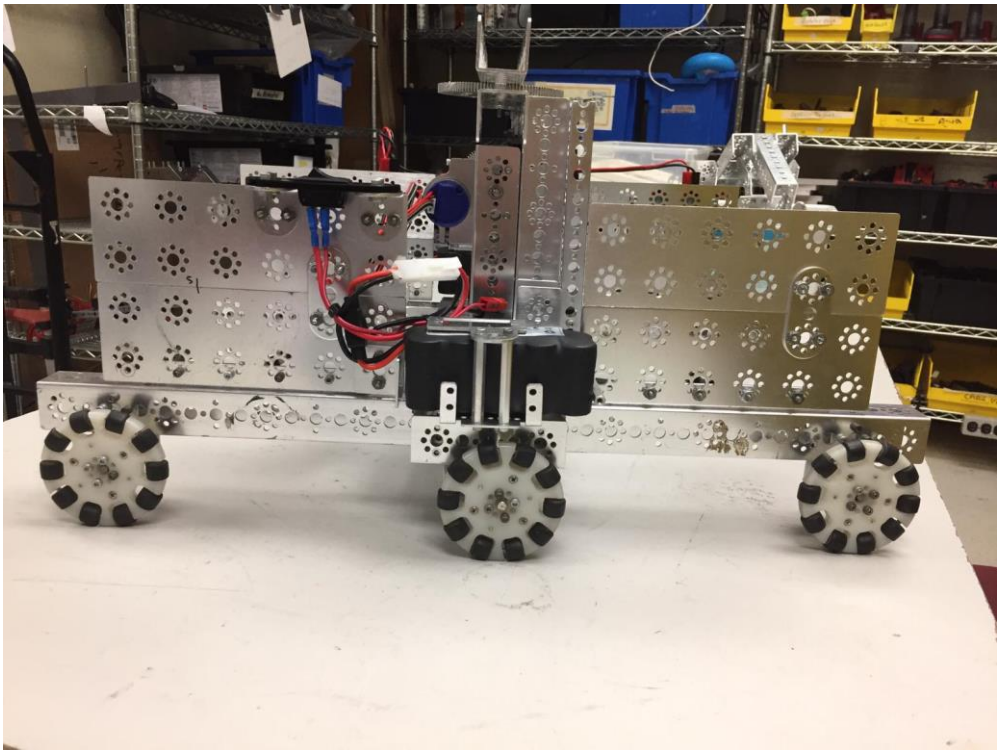
After the strategy phase, the team begins to transition into developing initial mechanism concepts. To determine which ideas will be most effective, each year the team undergoes a rapid-prototyping phase. The entire team is focused, and each group presents different ideas and then, the results of each idea to the rest of the team. From there, the team selects the most efficient and effective prototypes for the formal design process. The following sections detail the various prototypes that were made to come up with the final robot concept.

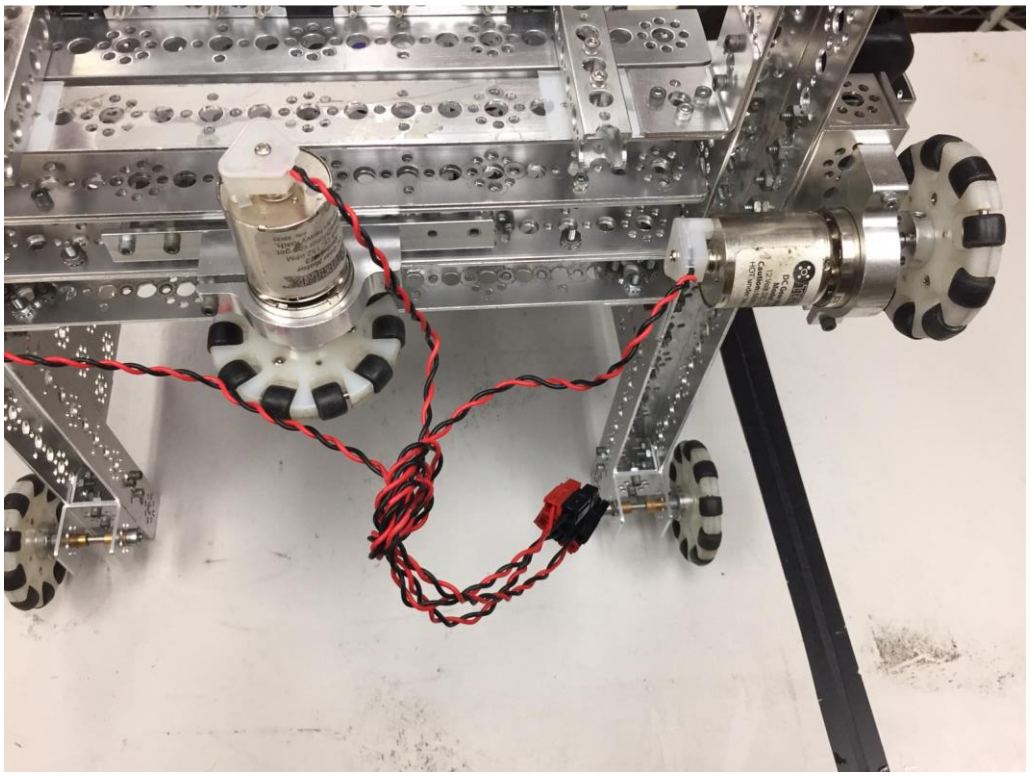
Our Prototype Gallery: 2019

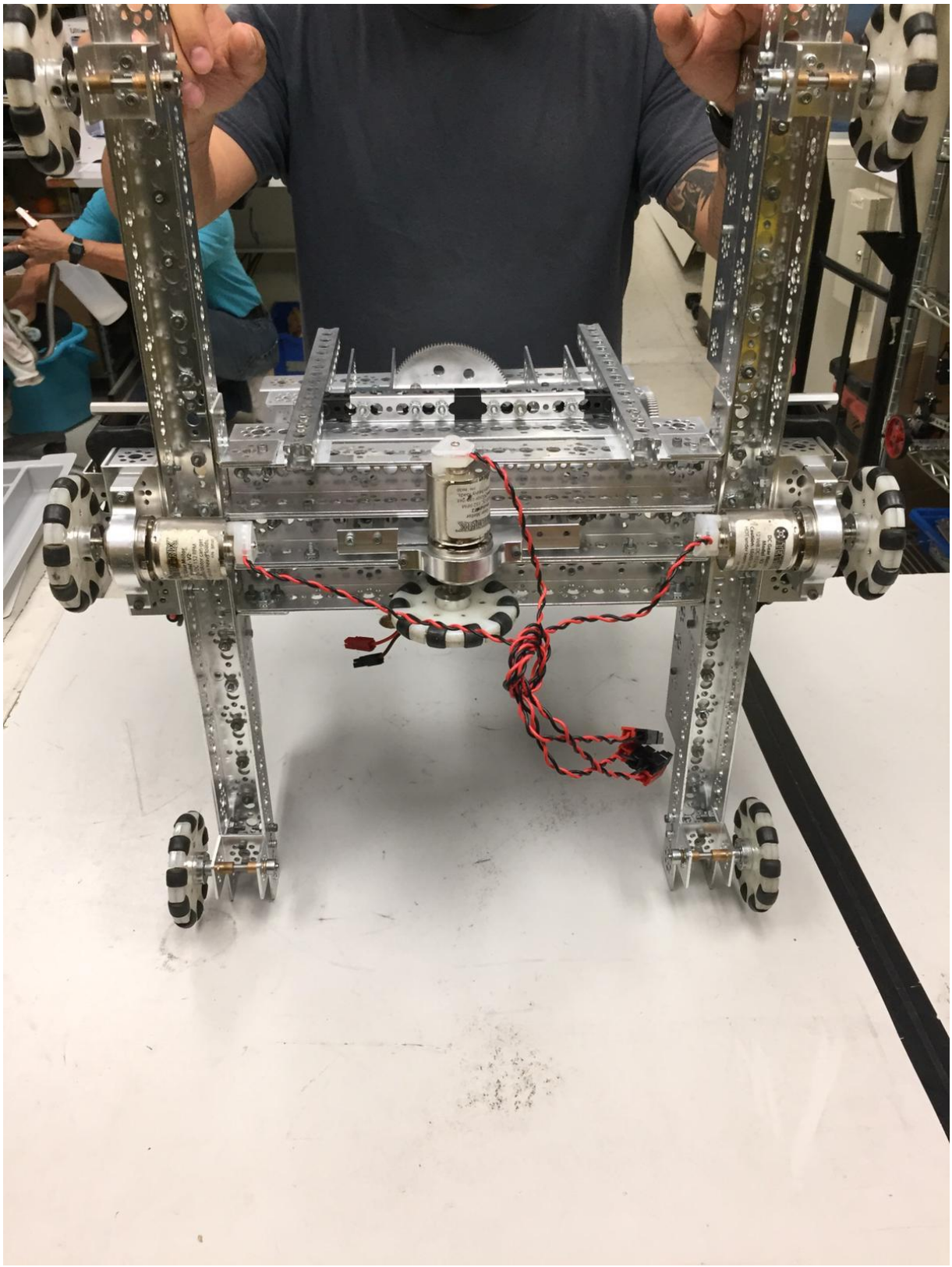


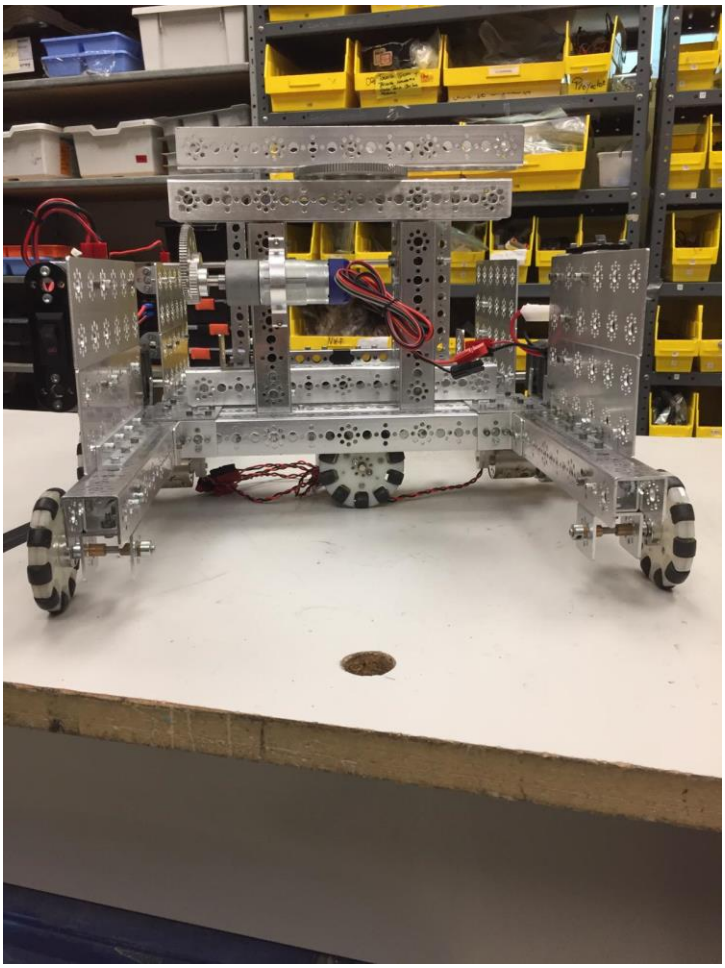


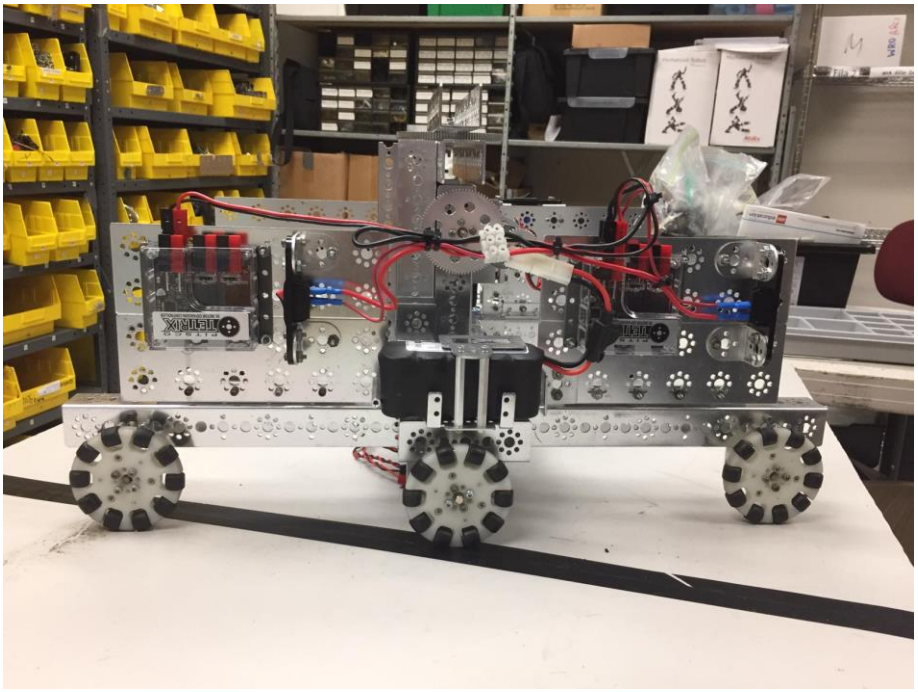


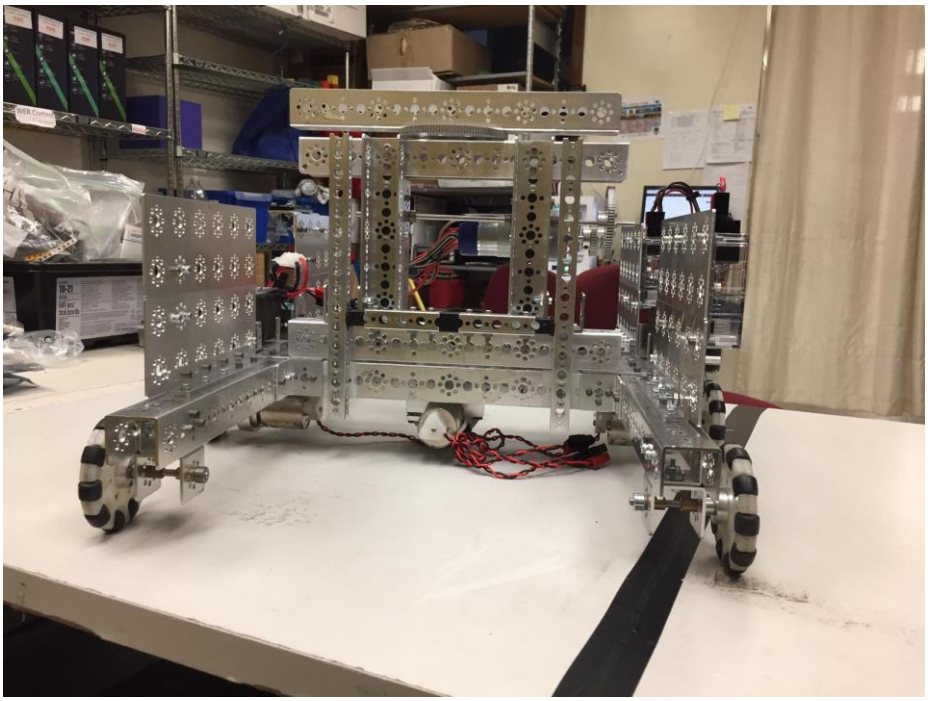








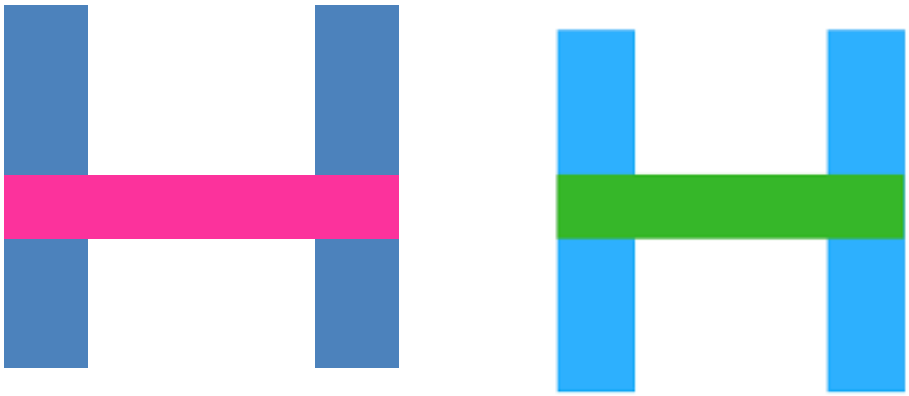




Methods and Functionalities:

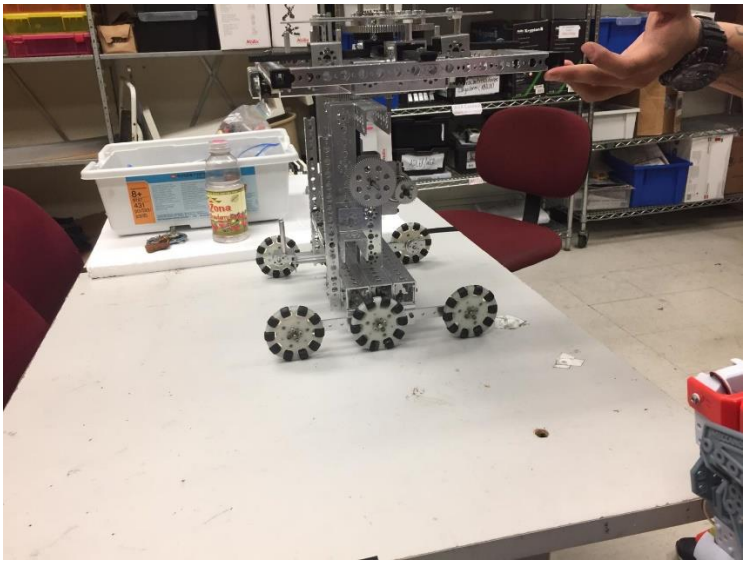
H-Shaped Base:

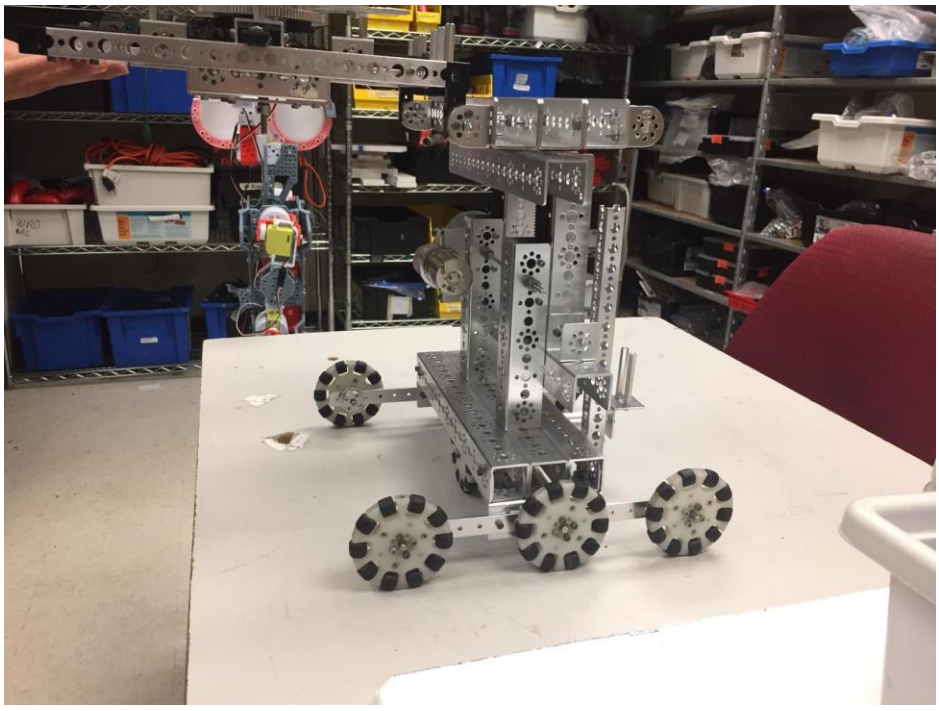
The H-Shaped Base is another sturdy base, using less metal than other bases. The central bar gives structural integrity while allowing for a front and back area for your game pieces. The central bar could be the initial center point for the robot operation, just as is the case with our project.

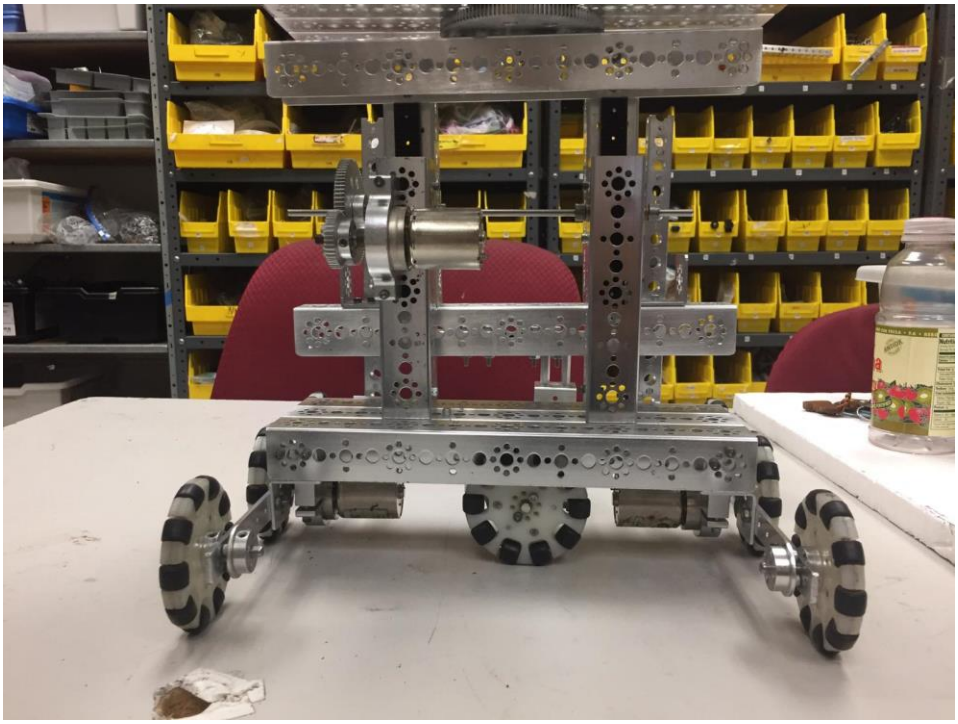


H-Shaped Base Configuration Model

Our H-Shaped Base



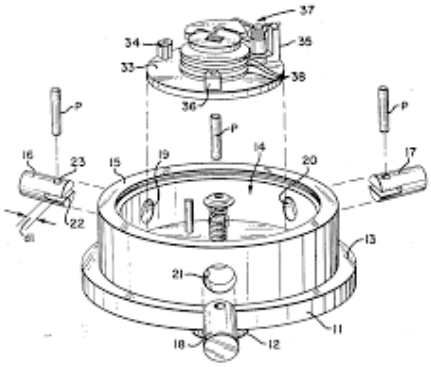


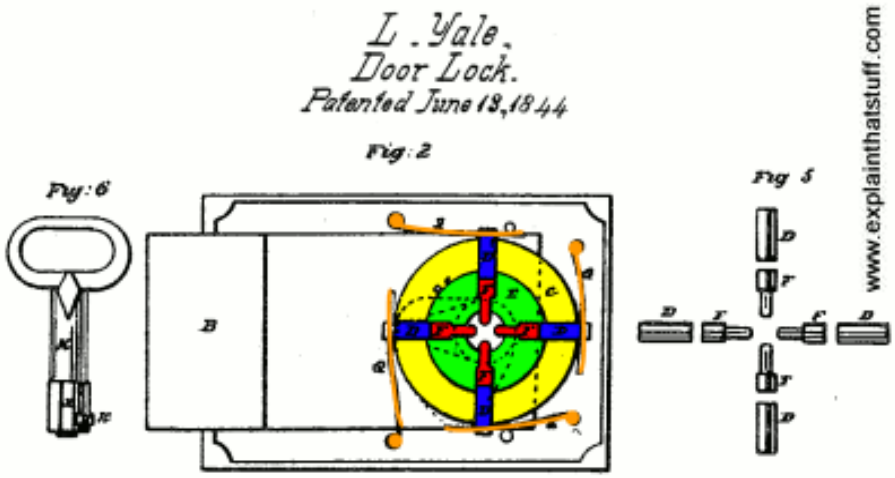


Gripping Mechanism:

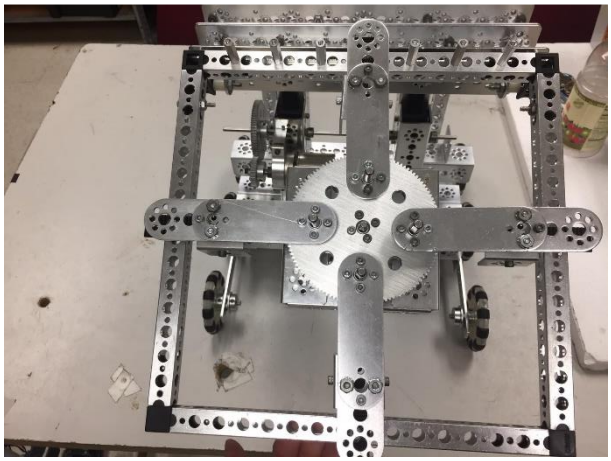
The gripping mechanism is used on both sides of the H-Shaped Base of the Robot. It was designed to hold four elements positioned at the four ends of each intersected line that make up a cross (+) type structure. This mechanism can contract and return to its original state-size again. It uses a single DC motor in the center of the mechanism where the lines that make up the cross technically intersect.

Sketches of Principle of the integrated Gripping Mechanism

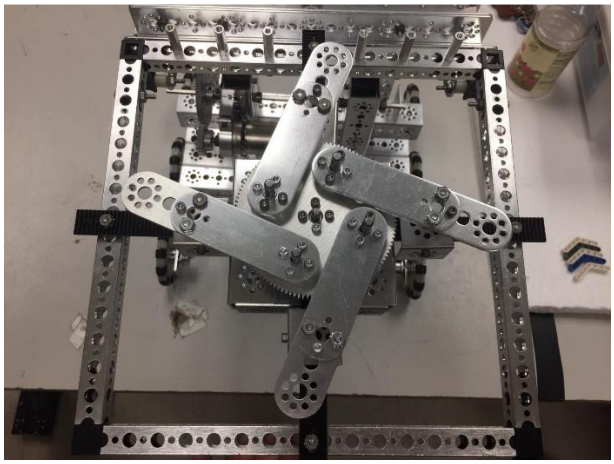




Our First Gripping Mechanism



Gripping Mechanism: Original Size



Gripping Mechanism: Contracted Form

All Special Sensors:

Particularly for sensors, we developed some practical ways to measure and evaluate the performance of the robot according to the construction materials. This was objectively designed to validate different technical points when taking the decision to purchase a new product.

The different tasks such as analysis, comparisons and others allowed us to know the situation in detail, the behavior and requirements of each of the indicators used to measure the performance of the Robotics Project, obtaining valid results that allow us to choose between various product types in the market, culminating later with the projection of a better work and performance, allowing to reach higher levels of effectiveness and efficiency.

QR-Code:

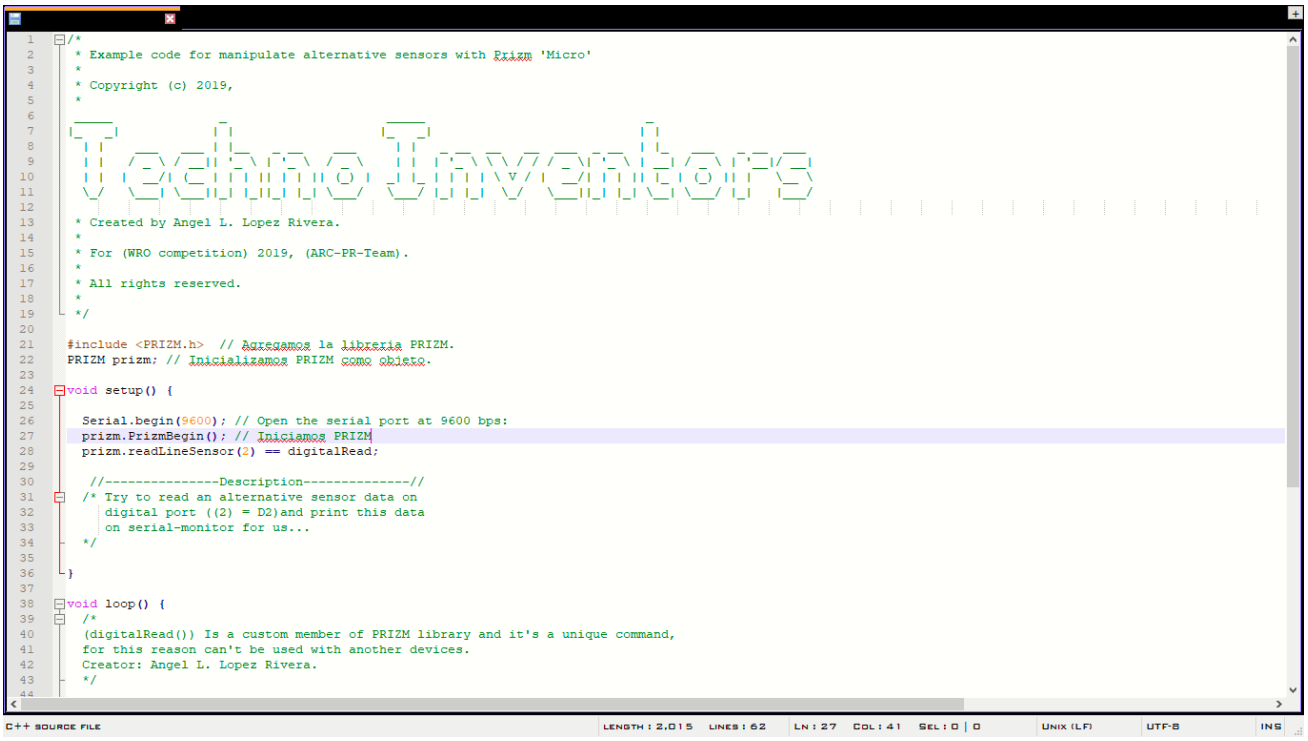
For the presence of QR codes as part of this year's challenge, the QR code scanner module is considered as the perfect tool to scan our QR codes anytime and anywhere. Additional, now you can easily generate, download and test them.

Vision-Sensor / Cameras:

For the detection of colors, formations, structures and other particular aspects, the use of cameras or vision sensors is considered highly viable. These modules must work from interfaces programmed with image processing algorithms such as the Viola Jones algorithm.

Basic Coding Example:

Our basic coding example using Arduino IDE for manipulate sensors with Prizm platform.



```
/*
 * Example code for manipulate alternative sensors with Prizm 'Micro'
 *
 * Copyright (c) 2019,
 *
 *  _____                _                  _____                                _
 * |_   _|              | |                |_   _|                              | |
 *   | |    ___   ___   | |__    _ __   ___   | |    ___   _ __    ___   ___   | |_    ___   _ __    ___
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 *
 * Created by Angel L. Lopez Rivera.
 *
 * For (WRO competition) 2019, (ARC-PR-Team).
 *
 * All rights reserved.
 *
 */

#include <PRIZM.h>  // Agregamos la libreria PRIZM.
PRIZM prizm; // Inicializamos PRIZM como objeto.

void setup() {

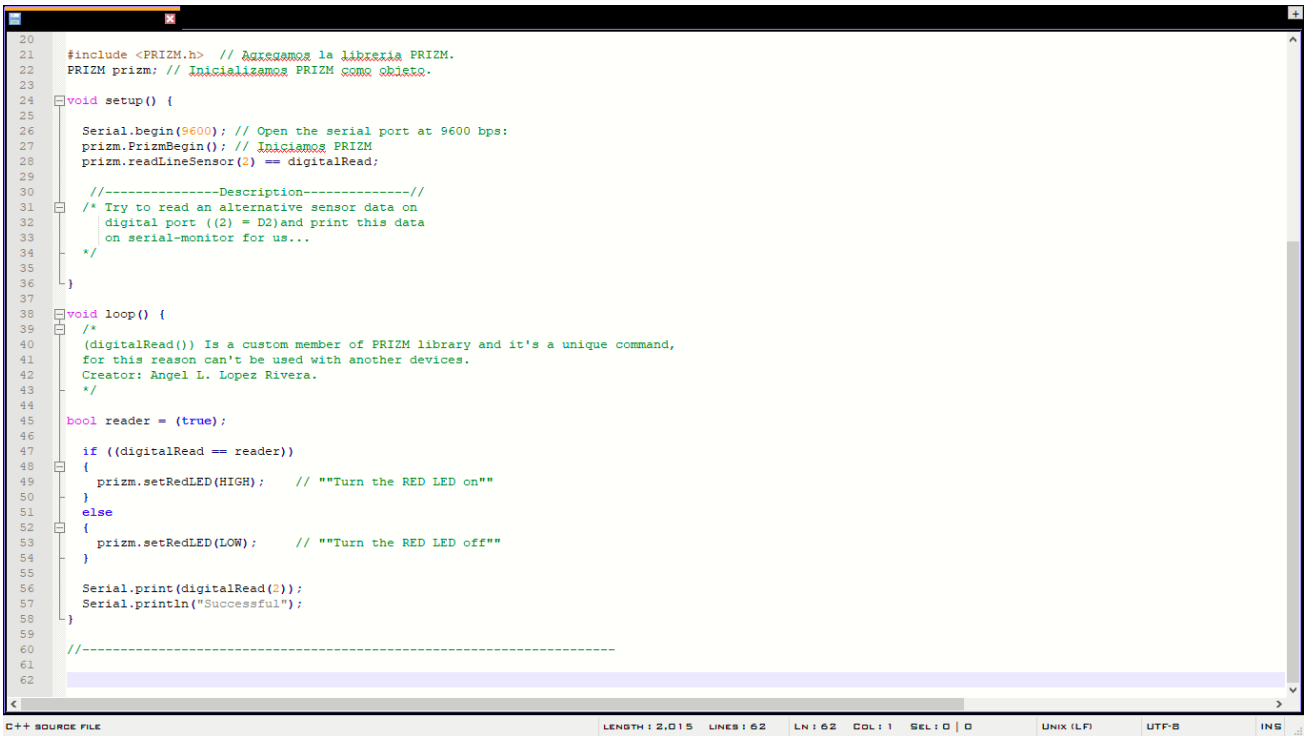
  Serial.begin(9600); // Open the serial port at 9600 bps:
  prizm.PrizmBegin(); // Iniciamos PRIZM
  prizm.readLineSensor(2) == digitalRead;

   //---------------Description--------------//
  /* Try to read an alternative sensor data on
     digital port ((2) = D2)and print this data
     on serial-monitor for us...
  */

}

void loop() {
  /*
  (digitalRead()) Is a custom member of PRIZM library and it's a unique command,
  for this reason can't be used with another devices.
  Creator: Angel L. Lopez Rivera.
  */
```

C++ source file | length : 2,015 | lines : 62 | Ln : 27 | Col : 41 | Sel : 0 | 0 | Unix (LF) | UTF-8 | INS



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}

void loop() {
  /*
  (digitalRead()) Is a custom member of PRIZM library and it's a unique command,
  for this reason can't be used with another devices.
  Creator: Angel L. Lopez Rivera.
  */

bool reader = (true);

  if ((digitalRead == reader))
  {
    prizm.setRedLED(HIGH);    // ""Turn the RED LED on""
  }
  else
  {
    prizm.setRedLED(LOW);     // ""Turn the RED LED off""
  }

  Serial.print(digitalRead(2));
  Serial.println("Successful");
}

//---------------------------------------------------------------------
```

C++ source file | length : 2,015 | lines : 62 | Ln : 62 | Col : 1 | Sel : 0 | 0 | Unix (LF) | UTF-8 | INS

Conditions:

Curious Questions:

- Which method is more effective for color detection?
- How do we constantly measure the perimeter area and analyze the data to save the readings?
- What type of interface, systems or libraries are compatible with our robotics project?
- How much could be the minimum and maximum measurable distance that a sensor can measure?
- How close to the center of the challenge track can be the initial box (Large box)?

Important Points:

QR: 85 x 85mm

Challenge Table:

Square Table: 2400 x 2400 x 200mm (+/-5mm): Inner height = 200mm

Wall Thickness: 50mm

Grid Cell: 115 x 115mm (+/-2mm)

Stroke Thickness: 1mm or less

Stroke Colors: Light Gray, PANTONE Cool Gray 5 C, RGB (177 179 179)

Parking:

Open Side: 362 x 379 x 345mm (+/-5mm)

Robot Dim. = 345 x 345 x 345mm

Cal. 345mm / 13.5827

Cal. 380mm / 14.9606

Cal. 17mm / 0.669291

Large Box:

Height: 200mm / 7.87402 (+/- 2mm)

Width * Depth: 230mm / 9.05512

Squares: 60 x 60mm / 2.3622

Small Box:

48 x 48 x 48mm / 1.88976 (+/- 2mm)

Cylinder: 15mm of diameter / 0.590551 (+/- 1mm)

Small Boxes Colors:

Blue, PANTONE Blue 072C, RGB (16, 6, 159)

Red, PANTONE 1759 C, RGB (238, 39, 55)

Green, PANTONE 802 C, RGB (68, 214, 44)

Orange, PANTONE Bright Orange C, RGB (254, 94, 0)

Yellow, PANTONE 803 C, RGB (254, 233, 0)

Large Boxes colors:

Blue, PANTONE Blue 072 C, RGB (16, 6, 159)

Red, PANTONE 1759 C, RGB (238, 39, 55)

Green, PANTONE 802 C, RGB (68, 214, 44)

Orange, PANTONE Bright Orange C, RGB (254, 94, 0)

Yellow, PANTONE 803 C, RGB (254, 233, 0)

Squares Color: Grey:

(RGB -86, 86,86-)

Free Space: 460 x 460mm

Conclusion:

The robotics has been constituted as one of the most controversial inventions that involves technology. There is a classification that locates the prototypes according to the use or purpose with which it was created, so the subject of robotics is an open field of everything that is mechanical engineering without excluding the programming being used for industrial engineering and currently used as competition topic. Robotics has many sides with different perspectives, for example it is used for a beverage machine to an informant on "alien planets". The truth is that any advances are made in the field of robotics, it will be honoring the advanced technology and the general basis of future science.

Puerto Rico: WRO-ARC Competitors: 2019

- Nashda Lee Sánchez:
  Designated Area: Mechanic

An excellent partner and good open-minded mechanic. Optimistic and intellectual woman. With great interest and passion for what she does. Ideal for any logistics and initiative issue.

- Ángel L. López Rivera:
  Designated Area: Programming

An excellent Inventor and good IT with extraordinary passion to learn about computing and new technologies. Focused in expand my knowledge, exchange ideas and contribute to the development of new forms of innovation.

Team Reference:

Principal Techno Staff:

- Ing. Gerardo Fernandez: Instructor
- POC. Aracelis Troche: Mentor
- Marisol Cabrera: Executive Director of PR Division
- Ing. Cesar Cabrera: President of Techno Inventors Inc.

Glossary:

- Pixy
- MyRio
- FTRobot.Zip
- Prizm
- ArduCam

References: 1

- WRO Association: https://wro-association.org/home/
- Pitsco: https://www.pitsco.com/
- Techno Inventors: https://www.technoinventors.com/
- Arduino: https://www.arduino.cc/

References: 2

- Arduino Sensor: http://agelectronica.com/AG/
- Others-1.1: http://protege.stanford.edu//
- ArduCam: www.arducam.com/