BAE Systems Mini-Bot Challenge #2
Color Conundrum

Color Conundrum is about choice. Which path for you, and which path for your robot? In this challenge, you must send your robot on its own journey, and then drive the robot on a different path. The choice is yours as to which is which.

This is a timed challenge. Registered FRC teams can submit one autonomous and one teleoperated entry. Teams must submit their code with their times. Teams must record their runs during the designated period and then submit their times, code and link to their video to the form located at https://bit.ly/3rhuIFM

Teams may only submit one set of runs per challenge. The runs do not need to be recorded with the same robot and on the same mat. Teams are encouraged to try different solutions and then submit their best time for their Autonomous and Teleoperated runs.

The designated recording period for Challenge #2 Color Conundrum is between 12:01 AM April 2nd and 11:59 PM April 3rd. All runs must be recorded during this time window. No submissions will be accepted before or after this time window.

3/11/2021 update

- Submission dates have been pushed out one week to ensure teams have access to mats.
- Sensors must be attached to the robot, and all sensor data must be processed by the Romi or by the Raspberry Pi. Sensors can pre-process data before handing it off to the Romi or the Raspberry Pi.
- Teams must submit one autonomous run and one teleoperated run. If the team chooses to submit an auto run from Course 1, then the teleop run must be from Course 2. If the team chooses to submit an auto run from Course 2, then the teleop run must be from Course 1.
- Scoring and awards are clarified in section 5, Scoring and Awards.

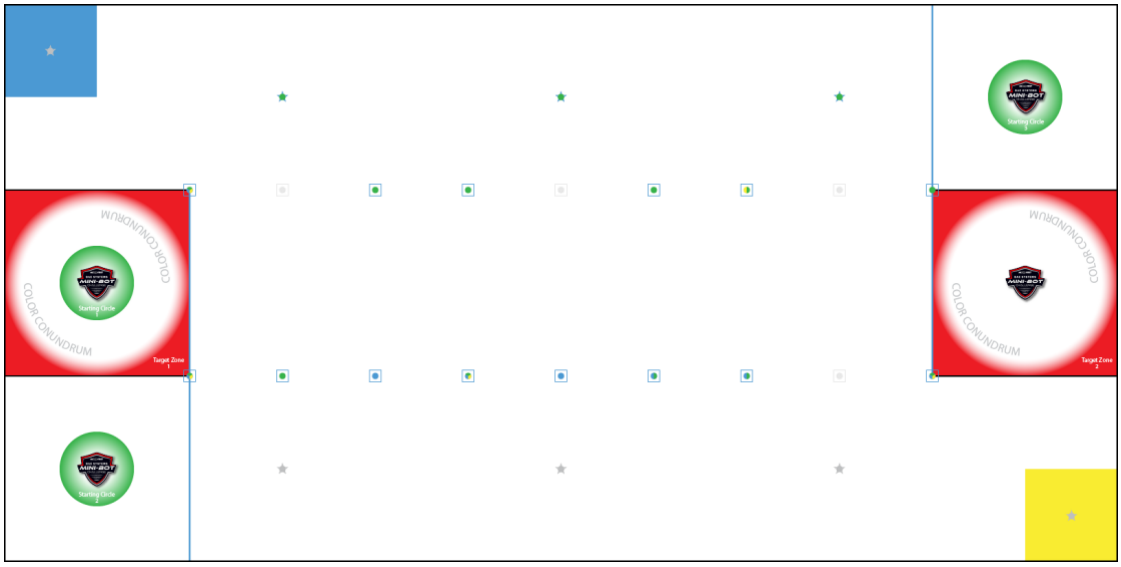
Challenge rules.

1. Robot
    a. Teams must use the “stock” kit provided by NEFIRST, or purchased as a kit to match the kit of parts in the “stock” kit.
    b. Additional attachments or sensors may be used.
        i. The team is free to design attachments or use commercially available attachments.
        ii. Attachments must remain connected to the robot at all times.
        iii. Sensors must deliver data to the robot, either to the Romi or to the Raspberry Pi.
        iv. Sensors must be attached to the robot, and all sensor data must be processed by the Romi or by the Raspberry Pi.

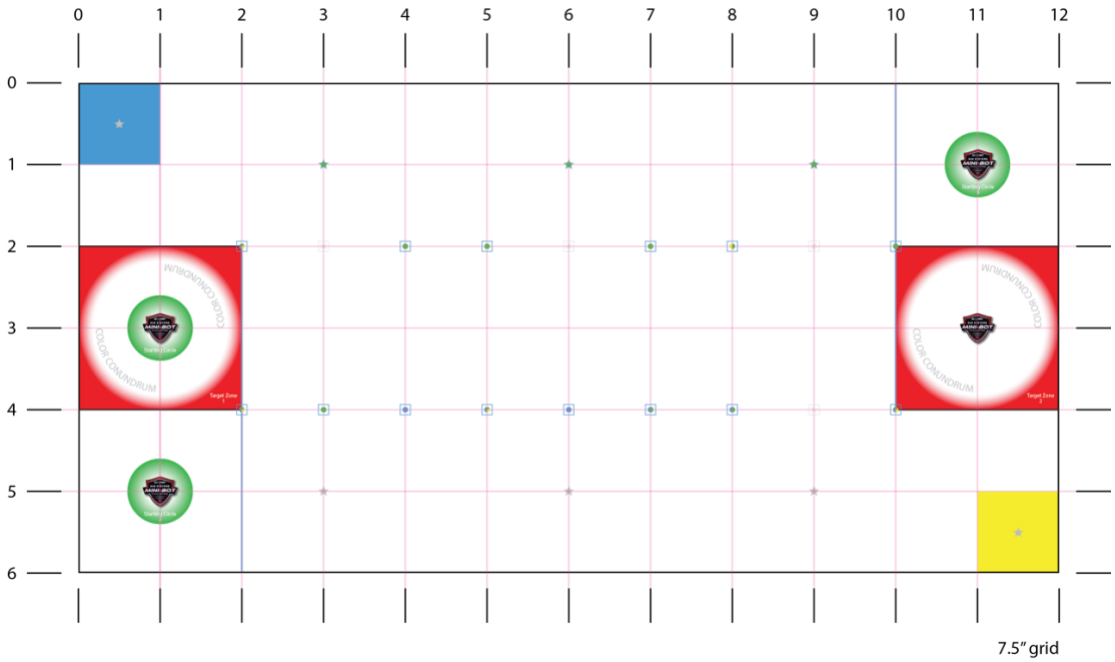
v. Sensors can pre-process data before handing it off to the Romi or the Raspberry Pi.

c. There is no weight limit for the robot.
d. There is no size limit for any attachments or sensors affixed to the robot, however robots must fit within the boundaries formed by black or blue lines around each Starting Circle. Once the run begins, the robots can expand to any size.
e. Extensions that touch the mat are treated as roller balls (at the point of contact with the mat) from the perspective of penalties.
f. Teams must use WPILib to program the robot.

2. Playing field (see Color Conundrum mat for print.pdf for full size)



a. This mat will be reused later in the competition.
b. Teams are encouraged to print out the supplied Field mat from PDF.
c. Teams can print as a single sheet on a wide-format printer or tile sheets together.
d. Instructions for tiling in Adobe Reader and Acrobat are found here.
e. When printed, the Playing Field should measure 45" x 90".
    i. All solid black lines are 0.125" thick.
    ii. All solid blue lines are 0.125" thick.
    iii. There is a black border around the entire field.
    iv. The field is laid out in 7.5" square regions.
    v. The field is 12 squares wide by 6 squares tall.



vi. There are three Starting Circles on the field.
   1. The Starting Circles are labeled as Starting Circle 1, Starting Circle 2 or Starting Circle 3.
   2. Each Starting Circle has a diameter of 6 inches.
   3. With the blue corner of the mat in the upper left orientation, the center of Starting Circle 1 is located 7.5 inches from the left outer edge of the mat and 22.5 inches from the top outer edge of the mat.
   4. With the blue corner of the mat in the upper left orientation, the center of Starting Circle 2 is located 7.5 inches from the left outer edge of the mat and 37.5 inches from the top outer edge of the mat.
   5. With the blue corner of the mat in the upper left orientation, the center of Starting Circle 3 is located 82.5 inches from the left outer edge of the mat and 7.5 inches from the top outer edge of the mat.

vii. There are two Target Zones on the field.
   1. The Target Zones are labeled as Target Zone 1 and Target Zone 2.
   2. Target Zones are two squares tall by two squares wide.
   3. With the blue corner of the mat in the upper left orientation, the center of Target Zone 1 is located 7.5 inches from the left outer edge of the mat and 22.5 inches from the top outer edge of the mat.
   4. With the blue corner of the mat in the upper left orientation, the center of Target Zone 2 is located 82.5 inches from the left outer edge of the mat and 22.5 inches from the top outer edge of the mat.

5. With the blue corner of the mat in the upper left orientation, each Target Zone has a solid black line bounding the top and bottom of the Target Zone.
6. With the blue corner of the mat in the upper left orientation, Target Zone 1 has a solid blue line bounding its right-hand edge.
7. With the blue corner of the mat in the upper left orientation, Target Zone 2 has a solid blue line bounding its left-hand edge.

viii. There are eighteen (18) 1" squares on the field.
1. The color of the perimeter of each square varies.
2. Each square has a .5" diameter circle at its center.
3. The color of each circle varies, and some circles consist of more than one color.

ix. There are eight (8) 1" stars on the field.
1. The color of the perimeter of each star varies.
2. Each star has a 0.5" diameter circle at its center.
3. The color of each circle varies.

x. Yellow, blue and red areas on the Field are treated as white for the purposes of penalties.

3. Game
   a. There are two courses in Color Conundrum (see below).
   b. Teams must complete only one run on each course.
   c. Teams must complete one autonomous and one teleoperated run.
   d. The two runs cannot be on the same course.
   e. There is no time limit for a run.
   f. At the start of their run, the robot's Romi circular frame must completely cover the Starting Circle for their chosen course.
      i. No portion of the Starting Circle can be visible when viewed from above the robot at the start of the run.
   g. Robots must move from the Starting Circle to the Target Zone of their chosen course.
   h. Robots must cross the blue line to enter the field from the Starting Circle.
   i. Robots must follow the path for their course (see below).
   j. Robots may not move or topple any obstacles during their run.
      i. Each toppled obstacle accrues one penalty.
      ii. Each moved obstacle accrues one penalty.
   k. Robots may not cross any black line in the course of their run.
      i. Crossing a line is defined as the point of contact between the wheels or roller balls and the mat moving from one area to another area while traversing a line.
      ii. Wheels and roller balls are allowed to touch a line in the course of their movement, so long as they do not cross the line.
      iii. Components of the robot that normally do not touch the ground are allowed to cover black lines.

iv. If a robot crosses a line from one area to another area and then crosses back to the first area as part of a turn, the run will accrue ONE penalty.

l. The wheels of the robot must cross a blue line to enter the Target Zone of their chosen course.

m. At the end of their run, robots must be completely within the Target Zone.
    i. Completely within the target zone means that it is possible to see the target zone around the entire robot in the submitted video, as shot from above.
    ii. If a robot extends to cover an area larger than the Target Zone, it must contract to fit within the Target Zone to be completely within the Target Zone.

n. Autonomous runs
    i. Autonomous runs must be controlled solely by robot code that is run in simulation mode on a computer.
    ii. All code must be started in simulation mode, and a connection established to the Romi MiniBot before commencing a run.
    iii. Code can be started from the computer connected to the MiniBot by activating the “Autonomous” mode on the driver station or simulation GUI, but no other human input is permitted.
    iv. Robots can use built-in internal sensors or attached additional sensors to control their robot. These sensors include but are not limited to wheel encoders, IMU or cameras.

o. Teleoperated runs
    i. Teleoperated runs abide by the rules of the Autonomous run, with the following additions:
        1. Robots must receive input from the Drivers' Station during the run to qualify as a Teleoperated run.
        2. The robot can use any amount of automation to assist the driver.
        3. Teams are free to design a Drivers' Station to suit the challenge.

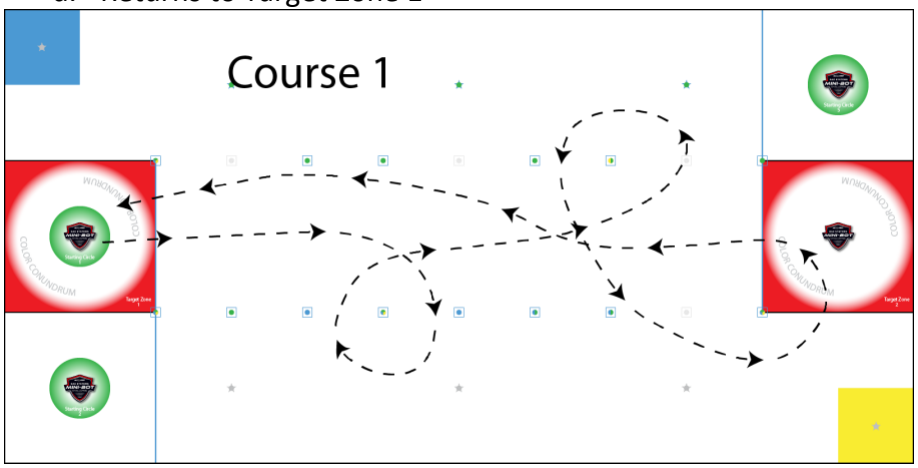
p. Run time starts when the robot begins to move from rest in the Starting Circle.

q. Run time ends when the robot comes to rest within the Target Zone.
    i. A robot is considered within the Target Zone when both wheels are in contact with the Target Zone.
    ii. It should be possible to see the Target Zone around all parts of the robot at the end of the run. A robot which comes to rest in the Target Zone but which overlaps the black border or the white chute will accrue a penalty (see below).

r. Penalties
    i. One wheel crossing a black line will accrue a 3 second penalty.
    ii. Two wheels crossing the same black line will disqualify a run. For instance, if a robot moves from the Starting Circle to the center of the field by driving across a black line with both wheels, the run will be disqualified.
    iii. Ending the run in the Target Zone but overlapping the black border or the blue line will accrue a 3 second penalty.

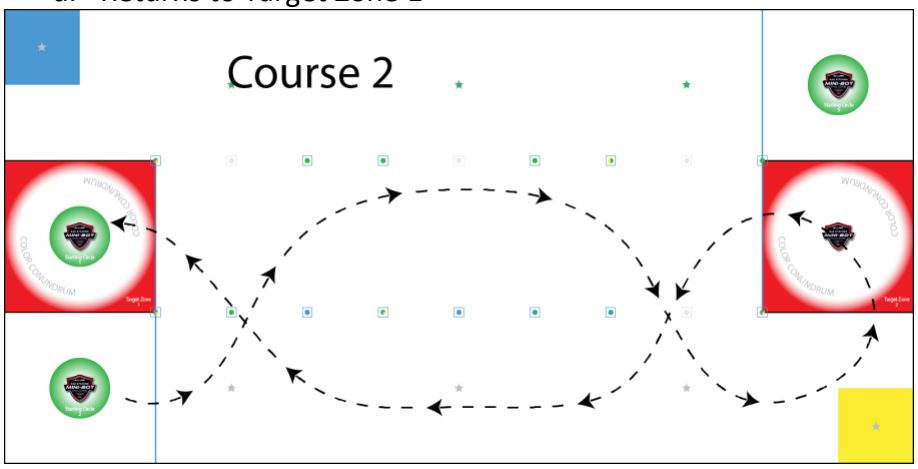
iv. Ending the run completely outside of the Target Zone will disqualify a run.
v. A robot that completely leaves the mat during the run will disqualify a run. To completely leave the mat, all points of contact between the robot and the mat must be outside of the mat's perimeter.
vi. Touching the robot during a run will disqualify the run.

s. Courses
   i. Course 1 starts in Starting Circle 1.
      1. Place AA batteries over the five small circles with yellow color. Some circles have more than one color. For this course, only cover circles with yellow. Some of the circles will also have other colors, so be sure to cover any circle with yellow.
      2. For this course, Target Zone 2 and its upper and lower boundaries do not exist, but the field boundary does exist on the right-hand side of Target Zone 2. Crossing the black lines at the top and bottom of Target Zone 2 will not accrue a penalty.
      3. The robot must follow a path that:
         a. Travels clockwise around the first battery outside of the Target Zone moving from left to right
         b. Travels counterclockwise around the second battery
         c. Travels counterclockwise around the third battery
         d. Returns to Target Zone 1



   ii. Course 2 starts in Starting Circle 2 (see Course 2 guide).
      1. Place AA batteries over the eight small circles with blue color. Some circles have more than one color. For this course, only cover circles with blue. Some of the circles will also have other colors, so be sure to cover any circle with blue.
      2. For this course, Target Zone 2 and its upper and lower boundaries do not exist, but the field boundary does exist on the right-hand side of Target Zone 2. Crossing the black lines at the top and bottom of Target Zone 2 will not accrue a penalty.
      3. The robot must follow a path that:

a. Travels above the first five batteries outside of the Target Zone moving from left to right
b. Passes below and counterclockwise around the last battery
c. Travels below the first five batteries from right to left
d. Returns to Target Zone 1



t. Visual guidance
    i. Robots may use visual inputs to help them navigate the chosen course.
    ii. Teams may add a fixed path to the Course, which the robot can track using the team's choice of line follower.
    iii. Teams may add other visual targets external to the field. These can be placed anywhere outside of the perimeter to aid navigation.
    iv. Aside from a fixed path, no visual aids can be added to the field.

4. Recording a run
    a. Each run must be recorded on video from above.
        i. The entire robot must be visible at all times during the run.
        ii. The mat is small enough for a person to hold a mobile device above the mat during each run.
        iii. Try not to record the run from an oblique angle. The referees need a clear view of the run to validate timing.
        iv. Due to the size of the mat, it may be necessary to follow the robot during the run.
    b. Each submission must include:
        i. The FRC team number
        ii. The total time for Autonomous run (not including penalties)
        iii. The total number of penalties for the Autonomous run
        iv. The total time for Teleoperated run (not including penalties)
        v. The total number of penalties for the Teleoperated run
        vi. Link to the robot code
            1. Code should be saved to a publicly available repository such as GitHub
        vii. Links to the two videos

1. Videos should be saved to a publicly available service such as Vimeo or YouTube
2. Use a private link to the videos
3. Use 1080p or higher quality when submitting each run

5. Scoring and Awards
    a. Teams must submit one autonomous run and one teleoperated run. If the team chooses to submit an auto run from Course 1, then the teleop run must be from Course 2. If the team chooses to submit an auto run from Course 2, then the teleop run must be from Course 1.
    b. Team scoring will be based on total time for both runs.
    c. There may be a Judge's Award.
    d. There will be an Innovative Solution award.
        i. Judges will review robot performance on the courses and robot code to evaluate this award.
    e. There will be an award for fastest combined time.
    f. There will be awards for fastest autonomous and teleoperated run times on each course.