UNIVERSITY OF MARYLAND EXTENSION

2024 4-H LEGO Robotics Challenge

The Bird Watchers

Birdwatching, also known as birding, is a popular **hobby** enjoyed by millions of people worldwide. It allows individuals to connect with the natural world and appreciate the beauty and diversity of bird species.

Observing birds in their natural habitats can be a calming and therapeutic experience. The peaceful surroundings and the gentle activity of watching birds can help reduce stress and promote relaxation. Successfully spotting a rare or elusive bird can also provide a sense of achievement and excitement. Birdwatchers often keep track of the species they have observed, creating a personal log of their experiences and discoveries.

Birdwatching provides numerous opportunities for learning about bird behavior, ecology, and conservation. Many birdwatchers enjoy studying field guides to deepen their understanding of birds and their habitats. Birdwatchers also enjoy photography or sketching birds, capturing their beauty and behavior in various artistic forms.

The **science** of birdwatching encompasses several disciplines, including ornithology, ecology, and conservation biology.

Ornithology is the scientific study of birds. Many birdwatchers participate in citizen science projects aimed at collecting data on bird populations, distribution, and trends to assist researchers.

Ecology is the study of the interactions between organisms and their environment. Birdwatchers observe birds within their natural habitats, paying attention to factors such as habitat preferences, food sources, nesting behaviors, and interactions with other species.

Conservation biology focuses on the preservation and restoration of biodiversity. Birdwatchers play an important role in conservation efforts by advocating for the protection of bird habitats, reporting sightings of rare or endangered species, and supporting conservation organizations.

Overall, birdwatching appeals to a wide range of people for its blend of outdoor adventure, appreciation of nature, learning opportunities, and sense of community. Whether it's a casual pastime or a lifelong passion, birdwatching offers something for everyone to enjoy.

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Manual Revisions

Date	Rev.	Description
2/14/2024	0.a	Draft Issue
2/15/2024	0.b	Updated Images
2/28/2024	0.c	Internal Review + Introduction
3/01/2024	1.0	Public Release

The Bird Watchers

The goal of the 4-H LEGO Robotics Challenge is to provide a simple LEGO Robotic game for entry level participants. This is done through a mission-based activity where youth design, build and program LEGO robots to solve defined tasks. The activity is performed on a 4' x 4' game mat, using pre-defined mission pieces. Each mission has points assigned, based on achieving a set goal. Although the missions are predefined, the solutions for achieving those missions are very open-ended, and depend on the creativity and skill of the participants. This document defines the rules and operating procedures for the 2024 game. If you have any questions, contact Willie Lantz at the Garrett County Extension office at 301-334-6960 or wlantz@umd.edu.

1 Teams and Coaches

Teams will consist of 3 to 8 members. The age range of team members may be defined by the local event organizers. Coaches of teams need to be official UME volunteers. If you are not a UME volunteer, contact your local extension office or the Maryland State Office at 301-314-9070 for information on becoming an official volunteer. Coaches also need to register through Maryland 4-H Online. A link is provided on the Maryland 4-H Robotics Page at:

https://extension.umd.edu/programs/4-h-youth-development/program-areas/stem

Coaches who are registered will receive updates on the game and competitions. Each team can register multiple coaches. Please do not register youth team members. There will be a later registration date for the Maryland State 4-H Robotic Challenge.

2 The Game

Team members will construct a robot, using ONLY LEGO parts. The robot will be controlled by a LEGO Mindstorm or Spike Prime Brick. The robot will autonomously perform specific tasks. The team will have 2 minutes and 30 seconds to perform as many tasks as possible.

2.1 Competition kit

The competition kit comprises the playing field "mat" and the Mission Models. The mission models are constructed from a LEGO Spike Prime accessory kit of parts. Competition kits can be shared among multiple teams. Use the link in section 1 above to locate a playlist of mission model build videos.

2.2 Field Mat

The field mat is a 48” x 48” vinyl banner which is mounted inside a wooden “playing field” for stability. The mat defines the various mission regions of the game and provides registration marks for positioning mission pieces.

THE FOLLOWING MISSION OBJECTS BEGIN IN BASE:

MIGRATING BIRDS X 3 (5.1)

INJURED BIRD (5.3)

NESTING PLATFORM (5.4)

FLOWERS (5.8)

BIRD SEED X 6 (5.9)

2.3 Playing Field base and perimeter.

The field will be constructed of a ½” thick sheet of plywood (48” X 48”) with 2” X 4” (1 ½” X 3 ½” actual measurements) on edge to create a playing area of 45” X 45” (inside the 2x4 frame). The mat (48” X 48”) will be installed between the 2” x 4” edge and the plywood. The playing field will be laid on a table or supported by two sawhorses 28” to 32” tall.

3 The Robot

3.1 Allowed Materials

Robots must be constructed using a single MINDSTORMS Brick (RCX, NXT, EV3 or Spike Prime) and any additional official LEGO parts. Non-LEGO parts will not be allowed. The robot must be programmed with LEGO supplied software to perform the tasks autonomously.

A maximum of the following motors and sensors may be attached to the robot during a run. This does not include "extra" robot manipulators brought to the table but not currently attached to the robot:

a . 2 x touch sensors
b. 2 x light sensors
c. 1 x ultrasonic sensor
d. 1 x LED lamp
e. 1 x gyro sensor
f. 3 x motors

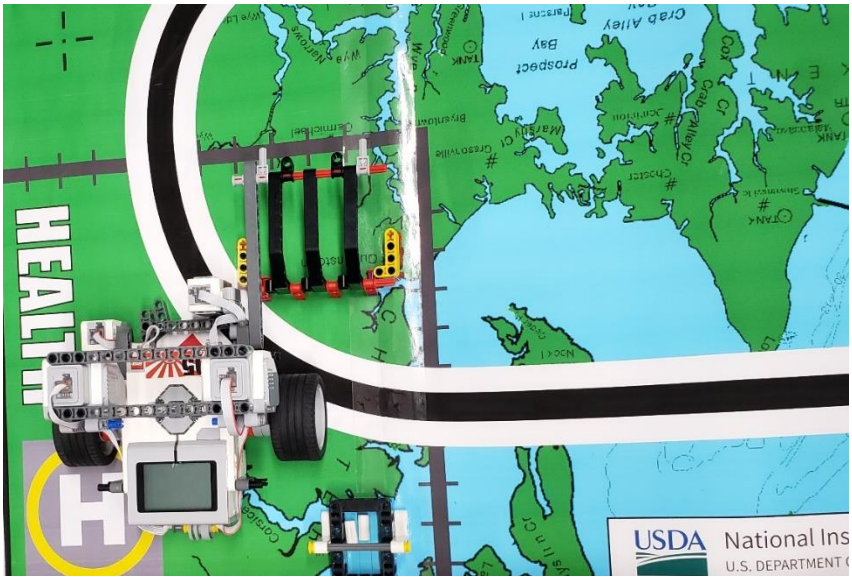
The following may not be used:

a. Paint, tape, glue, and oil
b. Non – LEGO stickers
c. Remote controls of any type

3.2 Robot Size

The robot and any attachments must start completely inside of the Base area of the board which measures 12" X 12" and must not be taller than 12". After the robot leaves the Base area it may expand to any dimension. For the 2024 LEGO Robotics Challenge, the Base Area is in the South-West Corner of the mat (**Heart H corner**). The actual base area includes the THICK perimeter line, but not the thin lines that extend beyond the THICK line.

Note: this photo is last year's game for illustration purposes only.



3.3 Robot Operation

3.3.1 Robot in Base

While in Base, members may change programs or change parts on the robot. The robot will be considered in Base if any part of the robot is within the Base Area perimeter once the match starts.

3.3.2 Handling the Robot

The robot may only be handled by the team members while the robot is in the Base Area. Once the robot completely leaves the Base area, or it contacts a Mission Model, then the mission is considered to be "under way". The member cannot touch, or in any way influence the movement of, the robot or Mission Model until it comes back to Base (any part of the robot breaks the plane of the base) without a penalty. See section 6 for more about Robot Touch Penalties.

Any Mission Objects that are to be brought back to Base must cross into the Base before a member touches the robot. Any mission that was in progress will be terminated if a member touches or in any way interferes with the robot while the Mission Object is still outside of Base**. If scoring pieces are in the control of the robot and have not crossed into base the points will not count and the pieces cannot be used for further missions.**

Teams may re-run the mission, but Mission Models will remain where they are when the robot was touched. The robot may leave Base and return as many times as time allows. Unless given explicit permission by the referee, team members may not touch any Mission Models or field components outside of the Base.

3.3.3 Mission Objects in Base

Some Mission Objects start the challenge within the Base Area. These may be loaded onto the robot or its attachments by hand. Only the robot may move them out of, or back into base. Once they have left the base with the robot, they may not be manipulated by hand until they return back to base. (*See 2.2 for mission objects in base at the start of the match*). The team may place the in-base objects pieces on a table outside of the playing field during the match.

4 Game Rules

4.1 Mission Objects

All Mission Objects are constructed from a standard LEGO Education Spike Prime Accessory Kit. Instructions for construction of mission objects will be provided on the State 4-H Robotics Challenge web site at https://extension.umd.edu/programs/4-h-youth-development/program-areas/stem/. Build instructions are provided in the form of assembly videos. As these videos may be updated to provide last minute changes, the Objects shown in the videos supersede images shown in this document. Teams should make every effort to construct Mission Objects according to the videos. A YouTube Video playlist can also be found here:

4.2 Robot Rounds

Each robot will play three rounds with the average of the three rounds contributing to the final score. Each robot round will last for 2 minutes 30 seconds. The round will be started at the referees call and the robot will be turned off by the referee at the end of the round. Teams will be given a minimum of 10 minutes between rounds.

4.3 Robot Operators

Two members will be allowed at the table during the robot rounds. Additional team members must stand in the designated area and may tag in and out during the round.

4.4 Scoring of Mission Objects

All scoring of robot missions is Based on the location of items **at the end of the match**. If an item is placed in scoring position and then moved by the robot, the item will receive the points for the final resting spot at the end of the match.

5 Missions

"Missions" are the definition of what the robot must do to gain points. Missions may be performed individually, or grouped together within a single program. Mission may have several different point values depending on the degree to which the mission is completed. Missions are defined in the following sections:

5.1 Migrating Birds (non-randomized)

Place each of the three migrating birds IN their correct designated area (A, B or C). The Yellow bird belongs in area A, the Green bird in B and Red bird in C. Birds do NOT need to be "completely in" their designated. Any part of the bird in the correct region will count. Birds MAY NOT be connected to each other or connected to any other LEGO parts at any time during the match.

Score: 10 points per bird in designated area.

The pictures above show all three birds in scoring position.

5.2 Migrating Bird "Long Distance" Bonus

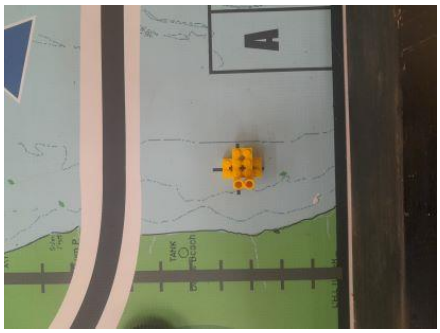
A Migration Bonus is available if the team wishes to use a color sensor to help a bird perform a long-distance migration. One of the three birds will be randomly chosen and placed on the field outside of base. The robot must detect the bird color and then deliver it to the correct X Y Z area of the field. If the team is going to attempt this mission, they must let the referee know before the match starts. The Migrating Bird Bonus must be the first mission the team attempts to get the bonus score for placing the bird in the correct area.

Once the team is ready, they will signal the referee who will roll the dice and place the matching-colored bird on the plus sign just outside of base. Once the referee rolls the dice the team cannot touch or interact with their robot till the referee starts the match. When the referee says "go" the team may only push the start button once. No other interaction of ANY kind with the robot or any other components, whether connected or otherwise, is permitted after the dice is rolled.

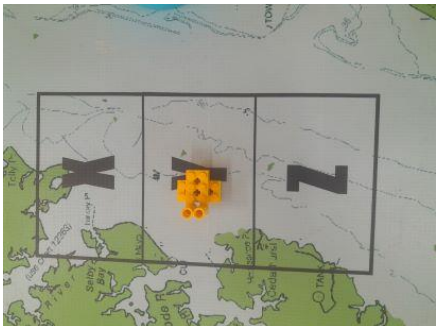
The robot must successfully place the bird **completely** in the designated square. If the bird is in, but not completely in the correct square it will only receive half credit for the mission.

Score: 60 points Completely In, or 30 Points In.

Bird Color	Dice Roll	Designated Area
Red	1 or 4	X
Yellow	2 or 5	Y
Green	3 or 6	Z



A



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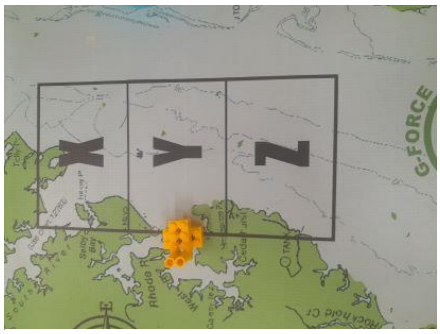


C

Picture A shows the yellow bird on the plus (randomized)

Picture B shows the bird placed completely in the designated area (Y). 60 Points.

Picture C shows the bird in (not completely) the designated area (Y). 30 Points.

5.3 Bird Rescue

The robot must deliver the injured bird from the base to the Hands box.

The bird can be fully or partially in the box .

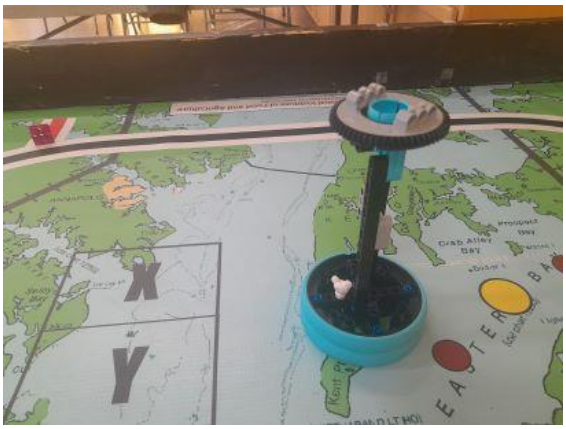
Score: 10 points in Hands Box.

Injured bird shown in Hands box

5.4 *Building a Nesting Habitat*

The robot must place the nesting platform (the assembled Lego turntable) on top of the tower. The tower will be dual-locked to the mat and must remain in the upright position to score any points.

Score: 25 points for a correctly placed nesting platform.

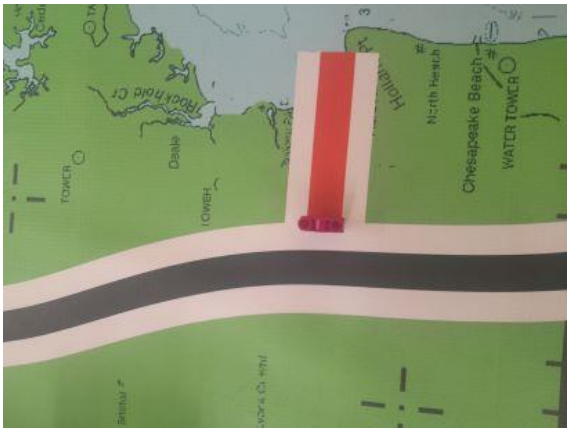


The nest may be placed in any direction on the tower. Both the pictures shown are in scoring position.

5.5 *Collecting Bird Counts*

The Robot will collect the four journals that are located at the red hash marks on the back line around the mat and deliver them to the Hands base area (completely inside the heavy black line (arc)).

Score: 10 points per book in Hands BASE (Max score 40 points).

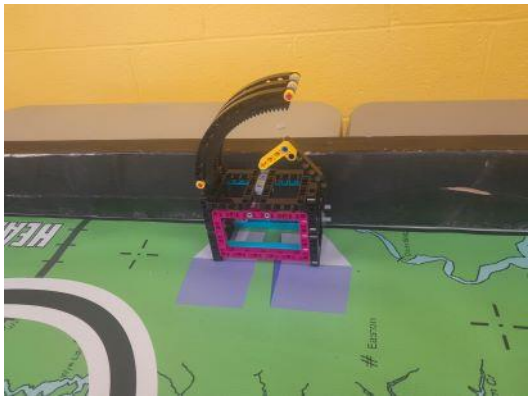


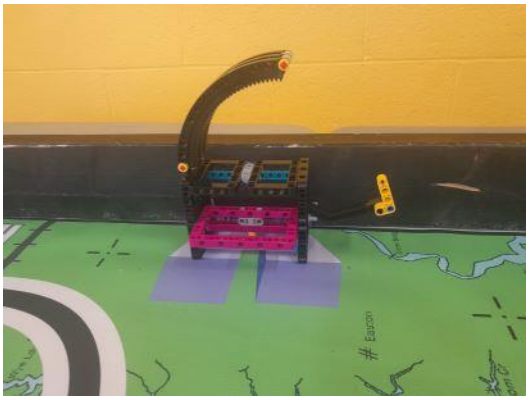
The picture above shows the location of each journal at the red hash mark. The picture to the right shows the location of all 4 journals and the scoring area completely inside the arc at the Hands area.

5.6 Bird Watching

The robot must prepare the bird observation blind by moving the yellow handle to the right (facing the model) to open the blind window. The window will open automatically (to the scoring position) when the handle is moved to the fully down position.

Score: 25 points for open Window





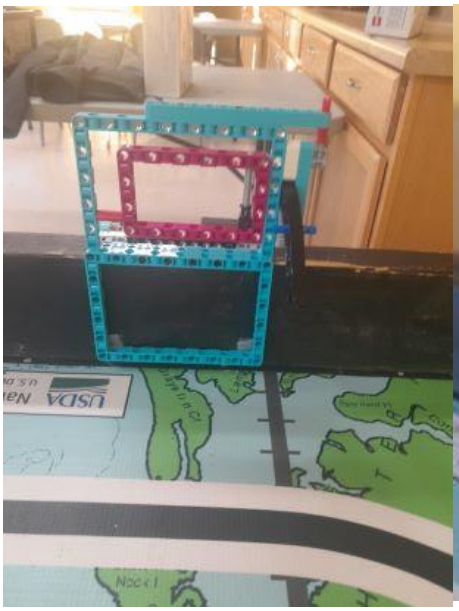
The left picture above shows the blind in the closed position and the picture at right shows the blind in the open position.

5.7 Wildlife Photography

The robot must push in the black lever towards the outside of the field to open the shutter on the camera.

The shutter (magenta rectangle) must be nearly 90^0 to the camera to be open.

Score: 25 points for an open shutter.



Left picture shows the camera in the starting position. The camera will be dual-locked to the side and top of the field perimeter.

Right picture show camera in the open position

5.8 Attracting Birds

The robot must deliver the flowers to Annapolis to attract more birds to this urbane area. Some part of the flower base must be touching the tan color to be considered “delivered”.

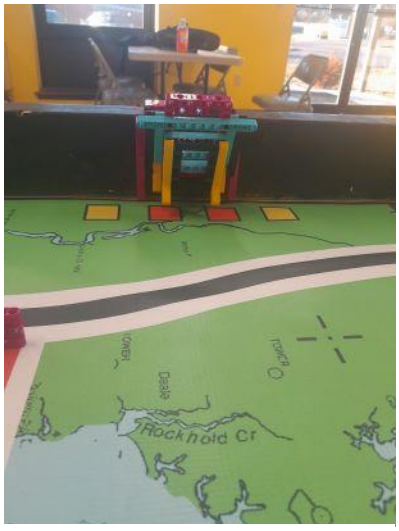
Score: 15 points for delivered flowers.

5.9 Feeding the Birds

The robot will open the bird feeder by lowing the platform (pulling it forward). The robot can then feed the birds by placing up to six feed pieces (round LEGO parts) in the feeder. The feeder will be dual-locked on top of the field wall. Any food pieces that are still in base at the end of the match will also score points. The bird feed will also serve as the touch penalty pieces.

Score: 20 points for lowering the feeder.

Score: 5 points per food piece completely in feeder, 3 points per piece in base (Max 30 points)



Bird feeder location

Bird feeder in the closed position

Bird feeder in the open position with the birdfeed inside the feeder

6. Touch Penalties

During the robot round, if the robot is touched while it is completely outside of the Base area it must be brought back to Base immediately and the team will be assessed a touch penalty.

For example, if a robot goes off course during a mission and does not return to base, the team may pick up the robot and return it to base, but the action will be assessed a touch penalty. Any game pieces that are in the robot at the time of the touch penalty that have been collected from the field will not be counted as returned to base or be allowed to otherwise be scored.

If the robot is taking a game piece to a delivery location which started the game in base and remains with the robot, the team may retry to deliver the game piece from base. Any game pieces that are touching the field outside of base or mission models that get moved may not be reset or recovered by the team. To assess the touch penalty, the referee will take one piece of bird feed for each touch penalty.

Feed will first be removed from the base, and then from the feeder.

7 Team Notebook

Each team should document the building of their robot in a journal. Each day that the team meets: record plans for the day, pictures and diagrams of robot building process, and ending reflections. The notebook will be shared with the judges during the technical presentation.

8 Technical Presentation

Each team will be assigned a 10-minute time period prior to the robot rounds to present to a panel of judges their robot's design. The presentation should include information on the team's design features, game strategies and programming. A game table with mission models will be provided. The team may utilize the game table to demonstrate the robot completing missions. A panel of 2-4 judges will rate the team's technical presentation based on the Technical Rubric (Appendix A). The team will be assigned a numerical score between 0 and 100.

9 Service Project

Through the service project, the team should conduct a service project related to birds. The team should share their project with a community organization or in an appropriate manner to help educate the public about birds. If a robotic program has multiple teams doing the same or a similar community service projects, be clear in explaining the roles of the team members in conducting the project.

9.1 Project Display

The teams should create a tabletop display that will explain their service project. The board should be displayed during the competition on the team's pit table and can be used during their presentation.

9.2 Project Presentation

The team will present a 3–5-minute presentation about their project to a panel of judges. The judges have 5 minutes to ask questions.

10 Mission Point Scoring summary

Mission	Description	Point Value
5.1 Bird Migration	If each bird is placed in the correct ABC area. **10 points each bird**	**30 points** Note if a bird is used for the migration bonus, the max points is 20. The maximum total for 5.1 + 5.2 = 80
5.2 Bird Migration **Bonus**	If the bird is **completely** in the designated XYZ area. **Or** If the bird is **partially** in the designated XYZ area.	**60 points** **30 points**
5.3 Bird Rescue	If the bird is moved to the hands area	**10 points**
5.4 Building Habitats	Nest placed on top of the tower	**25 points**
5.5 Bird Counts	Collect journals and take to Hands base area **10 points each journal**	**40 points**
5.6 Bird Watching	Opening the observation blind	**25 points**
5.7 Wildlife Photography	Opening the camera shutter	**25 points**
5.8 Attracting Birds	Move the flowers to Annapolis	**15 points**
5.9 Feeding Birds	Open Bird Feeder Feed Birds – place feed pieces in feeder. **5 points per piece in feeder** **3 points per piece in base**	**20 points** **30 points**
	Max Points	**270 Points**

Appendix A - Maryland 4-H Lego Robotic Challenge – Robot Technical Presentation Rubric

Robot Design	Evidence of structural integrity, constructed in a manner to allow for multiple tasks appropriate for the game, efficient use of parts.				
	Beginning (1-point each)	Developing (2 points each)	Accomplished (3 points each)	Exemplary (4 points each)	Score
	O Quite fragile & breaks a lot O Repairs and adding attachments take considerable time O Little use of manipulators O No sensors used for positioning O Very basic robot design	O Frequent faults or repairs O Parts of the robot do not fit well together O Simple manipulators O Limited or no use of sensors O Basic robot design with good balance	O Limited faults or repairs O Parts of the robot fit and function well together O Manipulators are designed and function well O Use of sensors for basic positioning O Robot design is sound and functions well with game	O No faults or repairs needed O Robot is streamlined and functions as a unit O Manipulators are well designed and perform tasks efficiently O Use of sensors for accurate positioning O Robot design is well thought out and performs task every time	
Strategy & innovation	Ability to develop and explain improvement to robot design that happened throughout the season including methods for making decisions and testing. Ability to clearly define and describe team goals and strategies for accomplishing goals. Creation of new, unique or unexpected features that are beneficial in performing the specific tasks.				
	Beginning (1 point each)	Developing (2 points each)	Accomplished (3 points each)	Exemplary (4 points each)	Score
	O Organization AND explanation of the team needs improvement O No clear goals O No clear strategy for accomplishing the mission O Robot has typical features and operates as expected	O Either team organization OR explanation needs improvement O Goals setting is ambiguous O Strategy is unclear O Robot has minimal features that are innovative	O Organization of the team is systematic and well explained O Team has good goals O Team has a clear strategy to accomplish tasks O Robot has features that are innovative that allow it to accomplish goals and strategies	O Organization is systematic, well explained and well documented O Team has document goals O Team has clear strategy to accomplish most/all game missions O Robot has many innovative features which allows the team to accomplish most/all game missions with accuracy	
Programing	Programs are appropriate for the intended purpose and would achieve consistent results, assuming no mechanical faults. Programs are modular, streamlined and understandable with documentation. Ability of the robot to move or act as intended using mechanical and/or sensor feedback (with minimal reliance on driver intervention and/or program timing).				
	Beginning (1 point each)	Developing (2 points each)	Accomplished (3 points each)	Exemplary (4 points each)	Score
	O Program is very basic relying on no feedback from the field O Program is not documented O Program is difficult to understand O Excessive driver interaction needed to aim/set robot before each mission O Robot completes missions infrequently or only after multiple attempts.	O Program is basic relying on little feedback from the field for positioning. O Program documentation is not complete O Program contains inefficient code O Driver must spend time to aim/set the robot before each mission. O Robot completes missions inconsistently or only after a few attempts.	O Program uses field or sensors to determine robot position on the field. O Program is documented and easy to understand O Program uses appropriate code complexity for tasks completed O Driver spends little time aiming/setting the robot before each round. O Robot completes missions consistently most of the time.	O Program uses complex code and sensors to determine position on the field. O Program is well documented and is easy for anyone to understand O Program uses streamlined code. O Robot position at the beginning of the match is not relying on driver aiming O Robot completes missions nearly every time and regardless of field conditions.	
		Over for Comments		Total Score	