

# 2012 IEEE Region 5 Conference Robotics Rules

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## Venue

The IEEE 2012 Region 5 Robotics Competition will be held at Oral Roberts University in Tulsa, Oklahoma. The competition hall will be open to contestants, spectators, and visitors throughout the event. A practice field will also be available for teams to practice and calibrate their robots before and throughout the competition.

## Contestant Eligibility

The competition is open to all undergraduate students attending IEEE Region 5 educational institutions. Teams may not include any non-undergraduate students. Contestants are required to register appropriately for the regional conference and student activities.

## Contest Description

This year's contest will preserve the tradition of compact mobile and autonomous robots operating on a predefined playing field. The challenge will be similar to the previous year's competition, to harvest energy from simulated renewal energy sources and deliver via an electromechanical device which will be used to determine how much energy was harvested. The competition will be won by the robot that harvests the most energy in the allotted timeframe.

## Entry Requirements

The robots will be screened by a judge before each round of competition. Entries not meeting the requirements will be disqualified for the round. These requirements take into account the scope and spirit of the competition.

1. Entries must be fully autonomous and self-contained. Human or remote computer intervention is prohibited during play. One way telemetry from the robot is **NOT** permitted as was in the previous year's competition.
2. The maximum dimensions of the robot are 1'x1'x1' high. The robot in its entirety should fit within this bounding box at the start, during, and at the end of the competition.
3. Entries must be generally safe in the opinion of the judges. The possibility of the robot causing harm to persons or property will be the deciding factor. This precludes the storage of flammable gases or liquids. Batteries should be enclosed in a way that will not present any danger to the operator or playing field.
4. Robots may not exceed a generous weight limit of 50 pounds.
5. An easily accessible "start/stop" button must be provided for the judges to initiate competition. This button must be distinct and separate from any other buttons.
6. A standard dual female banana receptacle (or dual binding posts with female receptacles) should be located at the top of the robot and wired directly to the energy storage mechanism. A shorting plug will be placed in the receptacle prior to competition to ensure the source is depleted.

# 2012 IEEE Region 5 Conference Robotics Rules

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## Objective

The course contains three different simulated sources of renewal energy, light, hydroelectric, and wind. In corner #1 there is a light on the back wall of the cubby. In corner #2 there is a simulated hydroelectric source at the back of the cubby. In corner #3 is a wind source situated on the back wall of the cubby. In corner #4 there is the flag mechanism for delivering and measuring the harvested power. And in the center of the field there is a starting tree where the robot will start.

Only harvested energy may be used to raise the flag. At no time may energy be transferred from internal batteries or other starting energy sources. This includes a direct or indirect transfer. For instance the robot may not produce harvestable light, electricity, or wind from its starting energy sources. Any light, heat, or wind generated by the robot must obviously not be harvestable by the robots harvesting mechanisms. The robot must harvest energy from AT LEAST two different sources during the round. This will be verified by a judge visually seeing a robot appearing to harvest energy from a particular source then delivering that energy to the flag and raising the flag. If a robot only harvests energy from one source their score will be recorded, but will not win over a robot with a score having harvested from the minimum of two sources.

## Playing Surface

To preserve local student branch investments, the same basic playing surface will be used as in previous years. This is an 8'x 8' surface constructed out of MDF or equivalent (two 4'x8' sheets). A quick repaint should bring previous teams up to date. The following paint is the same as last year:

White – Rust-Oleum – 1990

Black – Rust-Oleum – 7776

The field is broken up in to four quadrants as in a graph, each with a cubby as shown in Figure 1. The perimeter of the playing field is constructed by affixing 1x6 lumbers around the edge. A 1x6 lumber is dimensionally 0.75" x 5.5" so from the playing surface up to the top edge of the perimeter board is 4.75 = (5.5" – 0.75"). The perimeter is painted black as are the small partition walls which create the corner pockets. The small partitions extend out 12" from the inside edge of the perimeter and have the same height relative to the playing field (4.75") thus creating a cubby that is exactly 12" x 12" I.D. with one edge open to the field. The Cubby's entrances are marked by 0.5" x 11" lines painted in black. The lines are centered left to right with the cubby I.D. and 1" apart on center going outward and from the cubby and vary in quantity relative to the quadrant as depicted in Figure 1.

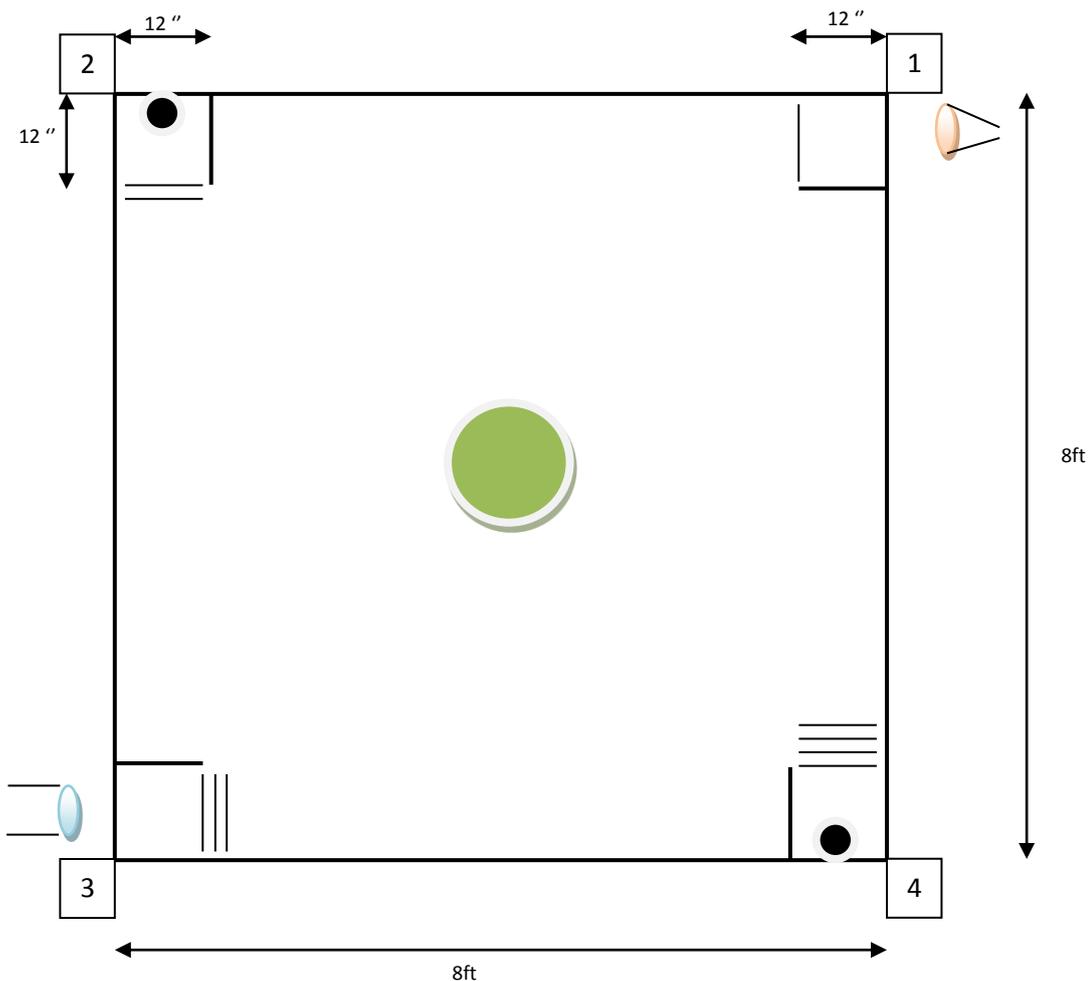


Figure 1 – Playing Field Diagram

## Quadrant 1 : Light Source

The light source is created by a standard MR16 – 50W halogen bulb (EXN/120V/50W/GU5.3/MR16CD ANSI) available at stores everywhere. The bulb will be powered by a standard 115V, 60Hz power outlet. The placement is outside the playing field such that the bulb is centered on and aimed straight at the cubby. Dimensionally it is a distance of 6" higher than the playing field surface to the center of the bulb and the front circular flat surface is a distance of 6" away from the inside surface of the perimeter of the playing field. No part of the robot may cross over perimeter of the field in an attempt to collect harvest light.

## Quadrant 2: Electric Source

The electric source will be the exact same as last year's competition's hydroelectric source. It will be a 5V Thevenin source with a 24Ohm Thevenin resistance. The mechanical housing of the source's base is a simple 3" PVC cap available at any hardware store. These conform to ASTM standard D2466 and are roughly 3.5" ID and 3.9" OD. The electrical contacts are 0.5" wide strips of thin sheet-metal (top ring positive). One way to make these is to buy inexpensive AC ducts and cut them to shape with shears. The flag is located per Figure 1 at the back of cubby #2.

# 2012 IEEE Region 5 Conference Robotics Rules

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## **Quadrant 3: Wind Source**

The wind source is created by a hair dryer, specifically at the competition it will be a “Style by Revlon 1875 Watt Dryer” available from Walmart: <http://www.walmart.com/ip/Style-by-Revlon-1875-Watt-Dryer/14551419>. The hair dryer will be set on “High” and have the “Cold Shot” button permanently depressed, therefore the heating element will be inoperable. The placement is outside the playing field exactly as the light source is in quadrant 1. The round end of the output duct is centered on and aimed straight at the cubby. Dimensionally it is a distance of 6” higher than the playing field surface to the center of the duct and the front circular flat surface is a distance of 6” away from the inside surface of the perimeter of the playing field. No part of the robot may cross over perimeter of the field in an attempt to harvest wind energy.

## **Quadrant 4: Delivery Flag**

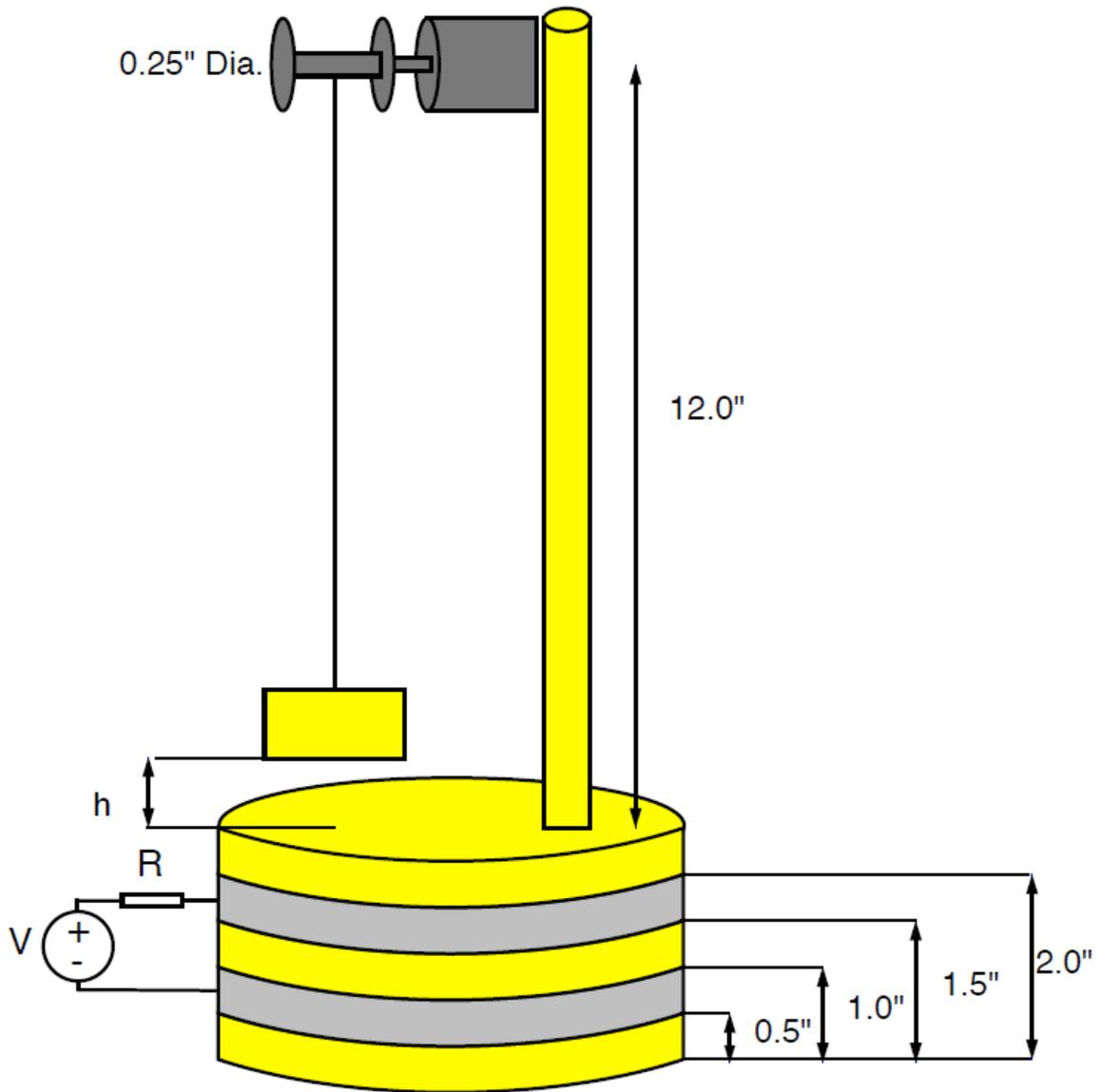
The flag assembly is the exact same simple mechanism as was used in last year’s competition, designed to deliver an exciting and tangible visual indicator of work done. For simplicities sake the assembly is actually a gear motor that raises and lowers a small block. The gear motor is part# 1094 from Pololu Robotics. The important point is that everyone will have the same load to power. To protect the motor from damage a zener diode in the neighborhood of 6v will be placed in parallel with the motor. Teams should not design their electronics to exceed 5v at the motor. The string will be very thin such that the impact of overlapping on the spool will not provide any tangible advantage in height. The flag presents a negligible load to the motor with such a high gear ratio. The mechanical housing of the base is a simple 3” PVC cap available at any hardware store. These conform to ASTM standard D2466 and are roughly 3.5” ID and 3.9” OD. The electrical contacts are 0.5” wide strips of thin sheet-metal (top ring positive). One way to make these is to buy inexpensive AC ducts and cut them to shape with shears. The flag is located per Figure 1 at the back of cubby #4.

## **Center Field: Starting Tree**

In the center of the field there is a standard white plastic 5 gallon bucket with a tree in it. The tree plays no functional role in the competition except to signify the spirit of the competition and conference (green technology). The robots starting position can be any which the team chooses such that a part of the robot must be touching the O.D. of the bucket and the surface of the playing field. This allows the team to aim their robot wherever they like for a starting position.

## **Source Switching:**

In an effort to make the competition more difficult the sources will be switched on and off during the round by a field controller system. The order and duration of the switching will be announced at a later time.



# 2012 IEEE Region 5 Conference Robotics Rules

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## Round Description

Each team will get 2 rounds of play. If the robot is able to harvest and deliver power to the flag, the final raised height relative (mm) to the flags starting point will be the score. The scores from both rounds will be added together to make up the final score. The top three teams will play one final round to determine the 1<sup>st</sup>, 2<sup>nd</sup>, and 3<sup>rd</sup> place winners. The rounds will proceed as follows:

1 – The judge requests the team from the “on deck” area.

2 – Students have 2 minutes to place their robot in the starting area and step back behind the predetermined team observation area. The robot must fit entirely in the starting cubby in quadrant 3 of the field.

3 – The judge will remove the shorting plug and measure the voltage of the energy storage mechanism. The voltage must not exceed 100mV.

4 – The judge will press the “start” button and begin timekeeping.

5 – The robot will have 5minutes of play to collect as much energy as possible and transfer it to the flag. Robots may use any of the sources and make as many trips as possible to and from the flag. Remember that sources will be switched on and off during the round.

6 – After 5min of play the robot will be stopped or may stop on its own. The height the flag was raised will be recorded by the judge.

If a robot leaves the playing field or for some reason no longer meets its size or safety requirement the round will be ended. The team captain may also give the judge a command to end the round for any reason at any time.

## Prize

A cash prize will be given to the winning team. Amount to be announced at a later time.

## Technical Award

A reward will be given to the team with the best technical report of their robot. This technical report will be judged on its ability for another scientist to use it to replicate the robot, and understand its theory of operation as in a peer reviewed publication. Amount to be announced at a later time.

## Questions to consider

1 – How can light be harvested from each source?

2 – How much power do you need to raise the flag?

3 – Which source can provide the most power?

## Contact Info

For questions regarding the rules please email Zachary Carpenter @ [zach.s.carpenter@gmail.com](mailto:zach.s.carpenter@gmail.com).  
For all other matters related to the robotic competition please contact the robotics chair, Hyacinthe Aboudja @ [haboudja@okcu.edu](mailto:haboudja@okcu.edu).