SoutheastCon 2022

Hardware Competition Rules

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1. Introduction

Mardi Gras (from the French “Fat Tuesday”) is the oldest American Carnival party, started in 1703 in the port city of Mobile, Alabama. Mardi Gras in Mobile has changed since then and it is now a multi-week celebration with school holidays for the final Monday and Tuesday (some include Wednesday), regardless of religious affiliation.

For weeks before the “Fat Tuesday”, crowds of residents and visitors can watch different parades in the streets of downtown Mobile with sights and sounds of live marching bands, brilliant-colored floats, and flying moon pies, and beads.

In 2022, besides the regular Mardi Gras parades, Mobile will host a national robotic parade competition, in which robotic floats will navigate through a smaller scale route performing similar tasks as our original Mardi Gras parade on streets. In this competition, your robot will be a float throwing beads and moon pies and cleaning up obstacles from the streets while avoiding hurting the audience and the beautiful buildings of our Mobile port city. Your float will also show your pride in your school, playing a fight song or displaying your mascot.

2. Objective

Develop a robot to autonomously navigate the Mardi-Gras route while performing tasks. The robot must complete the track and/or achieve the highest possible score by making multiple rounds within the time frame.

3. Competition

The robot will traverse an L-shaped track. On the track, there will be a randomly placed obstacle (colored marshmallow) to be pushed off the track, Mardi Gras beads to be retrieved from a “tree” at the start of the course, and fishnets into which the beads will be thrown by the robot. **(Important note: Here in Mobile, we use the term “bead” to refer to a closed loop containing beads. That is, a “bead” is a necklace or bracelet of beads, not a single bead.)** See the details below. Robots will receive bonus points if they include decorations that light up, move, and/or play music. Having a college-themed robot is encouraged -- use your school’s mascot and fight song, for example.

Your robot will have 3 minutes to autonomously navigate the Mardi-Gras parade route (game board) and complete tasks to earn points. The competition will be conducted as a series of rounds as described below:

- There will be 3 rounds: a qualifying round, a semi-final round and a final round. All teams can play in the qualifying round. Only the top 20 teams will be able to participate in the semi-final round. The best 4 teams out of the semi-final will participate in the final round.
- The qualifying and semi-final rounds will consist of 2 back-to-back runs through the track. The best scored runs will be scored and used to move forward to the semi-final and final round. If the team scores the max amount of points within the run, the time in which the robot maxed out the points and finished the run will also be used for scoring/placement. The highest scoring/fastest maxed point runs will advance through to the final round.
- A full run is from the starting point, to the turn around point, and back to the initial starting line. That is when the timer will be stopped unless the team says they are finished otherwise.
- During the rounds, the robot may collect points by pushing marshmallow off track, dropping beads into bins, and throwing beads into net. If the robot ventures onto the sidewalk, bumps into the barricade, touches the power line or damages the game board, you lose points. This is described further in the following rules.
- In the qualifying and semi-final rounds, if the robot achieves maximum points before the 3 minute timer runs out, the fastest track completion time will be used to be placed into the semi-final and final rounds respectively. The device being used for measuring the time/person is TBD.
- The final round will consist of how many points the robot can score within three minutes, with an unlimited number of course traversals permitted. The teams will have 2 runs and the best run will be recorded as the final score. The robot can progress the track as many times as necessary.
- The final round of competition will be held on Saturday night during the awards banquet.
- The team with the highest score will be declared the SoutheastCon 2022 Hardware Competition Winner. Standings will be announced at the awards banquet.

4. Game Format

1. Teams will be assigned a play order which will be announced in advance. This play order will be maintained for all rounds of play.
2. Teams must qualify 30 minutes prior to their scheduled play slot. They must attest at that time that they will not make modifications to their robot physically afterward.
3. Teams will be called one at a time and have 2 minutes to arrive.
    a. The play order is announced ahead of time and teams are expected to be aware of the time and call order thus far. For example, they should be prepared to go early, should there be a forfeit or otherwise.
4. Obstacles will be placed on the board by the judges prior to team arrival.
5. Beads will be placed on the "trees" prior to team arrival.
6. Teams are advised to designate a robot handler.
    a. Remaining team members are requested to maintain a 2 foot distance from the board (as marked on the floor).
    b. Spectators must maintain a 6 foot distance from the board.
7. A 1 minute setup period will begin upon team arrival.
    a. Teams must place their robot on the start line.
    b. Teams may adjust their robot as necessary.
8. Judges will announce the start of the round once the setup period is complete.
    a. A timer will be started for the round duration of 3 minutes.
9. A single team member, ideally the robot handler, should press a single start button once the Judges announce the start of the round.
10. No further physical interaction between the robot and people present is allowed during the round, "hands off" period.
11. The robot must run autonomously without any communication.
    a. *Illegal communication with the robot, such as wireless communication, visual communication, or auditory communication outside of the setup period will result in automatic* ***disqualification*** *for that round.*
12. Judges will announce the end of the round once the timer completes.
13. Judges will end the round if a team makes contact with their robot.
14. Teams may declare the end of the round in the event of emergency, idleness or otherwise.

5. Game Board

The game board is constructed with materials from most hardware stores. Teams are advised to construct a game board along with all the additional components. A diagram, with measurements, of the game board is shown on the next page in Figure 1.

Further details about the Game Board are described in Appendix A – Game Board and Objects Specifications. Details regarding paints are described in Appendix B – Building Material Recommendation, details regarding construction are described in Appendix C – Construction Recommendations, and a parts list is shown in Appendix D – Parts List.

1. The game board is a single 4’ x 8’ sheet of smooth sanded plywood.
2. The game board will include a black “roadway” in an L shape. The robot is to stay on the roadway at all times. The roadway will be lined with 2” tall barricades.
    a. Points will be lost if the robot touches or runs over barricades.
    b. There will be gaps in the barricades to permit the marshmallow to be pushed off the road without penalty.
3. There will be two “trees” along the course. One at the starting point, and one at the end. Both trees will be on the same side of the track. All beads to be thrown or dropped will need to be harvested from the trees at one of these locations.
    a. There will be 10 beads on each tree in the qualifying round
    b. There will be 15 beads on each tree in the semi-final round
    c. There will be 20 beads on each tree in the final round.
4. There will be colored marshmallow placed randomly on the roadway. It will need to be pushed aside by the robot.
    a. There will be gaps in the barricades to permit the marshmallow to be pushed off the road without penalty. Pushing it aside should not knock over any barricades.
5. The roadway will be lined with “trash bins” and fish nets. Their positions will be random along the roadway.
    a. There will be 4 trash bins and 3 fish nets.
    b. Trash bins will be placed such that the outer edge of the cup is four inches from the edge of the roadway.
    c. Fishnets will be placed such that the center of the net is four inches from the edge of the runway.
6. There will be a “power line” across the track. The robot must fit under the power line and within its supporting power poles.
7. On the outside of the game board, along the outer edge of the plywood, there will be several “buildings”. Points will be lost if the robot touches or knocks over the buildings.

8. **Start Square:** Starting position of the robot.
    a. A 1’ x 1’ square corresponding to the size restrictions of the robot.
9. **Roadway:** the black L shape on the game board.
10. **Barricade:** obstacle lining the roadway, 2” tall. There will be a gap for the marshmallow.
11. **Tree:** One at beginning and end of roadway. See map for examples of placement.
    a. Wooden dowel, ⅞” diameter, 2’ tall
    b. Tree limb placed at 21”, tree limb extends 6” outward
12. **Trash Bin:** red Solo brand cups or similar cup with specified dimensions.
    a. 4 ¼” high, 3 ½” top diameter, 2 ½” bottom diameter.
13. **Fish Net:** nets representing the audience that catches thrown beads
    a. Net 8 inches in diameter and mounted on a pole 5½” inches tall.
14. **Power Line:** rope between two poles.
    a. Will stretch across the track, with 2’ gap between supporting poles.
    b. Poles will hold it 2’ above the track.
    c. Sag in power line not to exceed 3”.
15. **Building:** cardboard box along the perimeter of the game board.
    a. Easy fold box U-Line or similar box with specified dimensions.
    b. 11 ⅛” height x 8 ¾” width x 4" depth

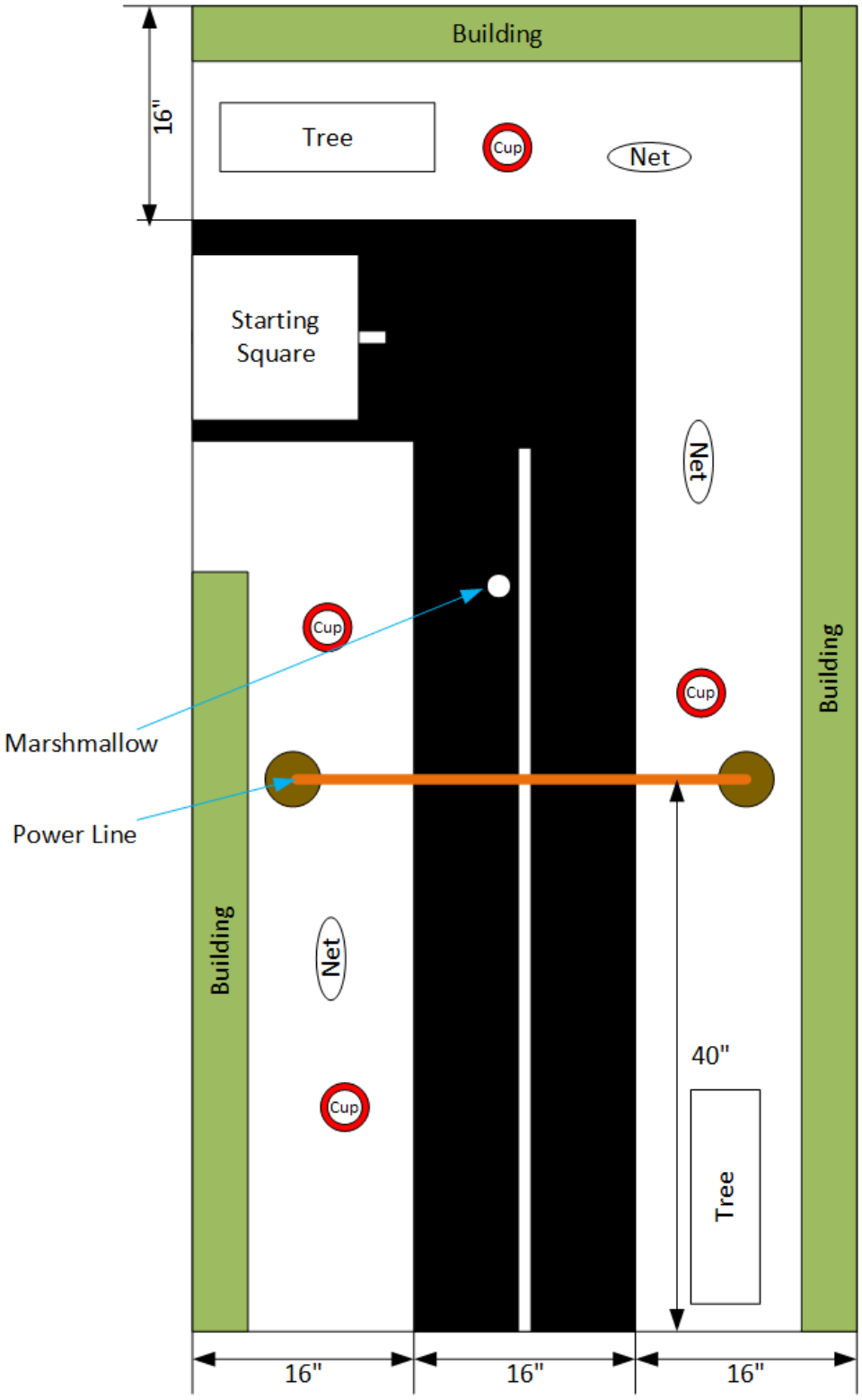

Figure 1. Diagram of course, top view

Note that the power line, cups, and nets will be randomly placed for each run.

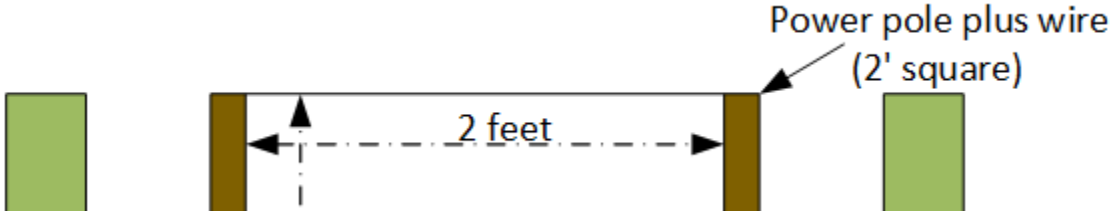

Figure 2. Elevation view of the game board.
Note that the marshmallow is not shown.

6. Robot Specifications

1. Robots must operate completely autonomously once started.
2. No wired or wireless communication is allowed.
    a. Evidence of such must be provided. Bashrc, rfkill, etc
3. Tethering or external control of the robot is prohibited and will result in immediate **disqualification** from the competition as a whole.
4. The maximum starting size of the robot will be restricted to 1’ x 1’ x 1’ (*i.e.*a 1-foot cube).
5. The robot may extend arms or appendages (or flags or figures) to complete the challenges throughout the course
    a. Appendages must at all times be wholly contained within the game board.
6. Robots may have one or more extendable appendages that go beyond the 1’ cube robot size requirement
    a. The robot **with** appendages must fold / constrict / and otherwise fit within the 1’ cube robot size restriction before play begins.
7. Robots must have a clearly labeled start switch.
8. It is strongly recommended that robots include an emergency stop.
    a. In the event of damage or malfunction gameplay must be halted.
    b. This may be a button, switch, mechanism, easily accessible power line, etc
9. Robots must be self-contained and remain a single unit, e.g. cannot break apart.
10. No aerial or flying robots allowed.
11. No explosive, pyrotechnic, toxic or corrosive materials. Flammable liquids or gases are prohibited.
12. We **encourage** robots to be decorated like Mardi Gras floats and display a school logo or mascot, school flag, state flag, etc. Mascots and figures are also encouraged, as are robots that play music and have a light show.
    a. Any flag or figure must fit within the initial size constraints of the robot.
    b. As noted elsewhere, it is OK for a flag or figure to deploy after starting and be outside the 1’ cube requirement.
13. You may choose to use Sonar and LIDAR sensors. However, be advised teams are required to handle any accidental interference from other robots or other noise sources.
    a. For example, many cameras have infrared rangefinders, and may accidentally interfere with infrared sensors.
14. While it is the team's responsibility to handle accidental interference, any intentional interference by another robot or team will not be tolerated and can result in immediate **disqualification** from the competition as a whole.
15. **Teams are responsible for the safety of their robot. With the game board being raised, teams should take extra precautions to avoid the robot falling off the game board as**

no modifications including padding will be allowed to or around the game board and floor. In case of such a falling instance, the team will automatically end the competition set and scoring will be up to that point.

16. **The robot shall not present any danger to the judges, spectators, playing arena, or area surrounding the arena. If at any time the judges deem the robot is causing or is likely to cause harm, the judge may terminate the match immediately. The judge will have the discretion of whether any points are awarded for that match and if the robot is allowed to compete in any remaining rounds. Especially noteworthy are any machines that throw -- they must not throw objects long distances or high speeds.**

7. Gameplay Rules

1. Teams will be assigned a play order which will be announced in advance, this play order will be maintained for all rounds of play.
2. Teams must qualify 30 minutes prior to their scheduled play slot, they must attest at that time that they will not make modifications to their robot physically afterward.
3. Missing the qualification announcement window will result in **disqualification** of the missing team(s) from *that round*.
4. Teams may test their qualification as many times as needed during practice.
5. During qualification:
    a. The robot must fit inside a box with inner dimensions as noted above.
    b. The start button and failsafe button must be specified.
6. Prior to the beginning of each round, the next team(s) to play will be announced. One team for each game board.
    a. Teams will be called one at a time and have 1 minute to arrive.
    b. The play order is announced ahead of time and teams are expected to be aware of the time and call order thus far.
7. Obstacles will be placed on the board by the judges prior to team arrival.
8. A 3-minute setup period will begin upon team arrival.
    a. Teams must place their robot on the starting square.
    b. Teams may adjust their robot as necessary.
9. Judges will announce the start of the round once the setup period is complete.
10. A single team member, ideally the robot handler, should press a single start button once the Judges announce the start of the round.
11. No further physical interaction between the robot and people present is allowed during the round, “hands off” period.
12. The robot must run autonomously without any communication.
    a. *Illegal communication with the robot, such as wireless communication, visual communication, or auditory communication outside of the setup period will result in automatic **disqualification** from that round.*
13. Team members are not allowed to touch their robot until the round ends or a team decides to terminate its participation.
14. As part of game play the robot may **throw** the beads in the fish nets or put beads in the trash bins. Teams will **not** earn points if the robot places the beads in the net, beads must be thrown. “Thrown” is defined as having at least a 4” horizontal distance from origin to destination.
15. Teams are encouraged to watch gameplay as spectators to support each other. Positive encouragement from spectators is strongly encouraged.

16. Robots must not damage the game board, cause a halt of competition, or require repair of the game board.
    a. Doing so will result in **disqualification** from the competition as a whole.
17. When addressing judges with questions, teams are expected to act within the IEEE code of conduct.
    a. Only one designated team captain can address the judges for written or verbal decision appeals.
    b. Calm demeanor, politeness, and professionalism are strongly encouraged.
    c. Violation of the code of conduct will result in **disqualification** from the competition as a whole.
18. Judges will interact with one team at a time -- other teams cannot "join in" while judges are speaking with a team. Any discussion relevant to all teams will be announced.
19. Flash photography will **not** be allowed. On-board lighting is allowed as long as the robot is not flashing nor interfering with operation of other robots on other game boards.
    a. Please be respectful of the frequency of any flashing lights you may use, for those that could be affected by strobing lights
20. In general, a "redo" will not be allowed for fairness to all teams. However, judges reserve the right to make a call in the event of external interference, such as power outage, disruptive feedback, and other reasonable issues in the field.
21. Every effort will be made to maintain courses between rounds, but in the interests of time minor scuffs (etc.) will not be addressed.
22. **All judges' / timekeepers' decisions are final.**
23. Judge's score sheets are **final**, score sheets returned to teams are for your reference only. Any point of dispute must be present on the **judge's score sheet** in order to be considered valid.
24. After each set, teams will have a 5-minute window (after their score is displayed) to file an appeal with the judges / timekeepers if they believe a scoring error exists.
    a. Teams should use caution in filing appeals. If an appeal is **declined**, Teams will be **deducted 50 points** from their competition set score.
25. Team shirts used to gain hardware competition points **must:**
    a. Display an identifiable Team Logo
    b. Be entered in the SAC sponsored T-Shirt competition.

8. Scoring

Scores are cumulative during the final round. Teams will be able to view standings and scores on a display located in proximity to playing fields, as well as digitally via google document.

Points	Task
+1 pt	Pushing a marshmallow off the roadway
+1 pt	Each bead dropped into a bin
+1 pt	Each trash bin with one or more beads in it
+1 pt	Each fish net with one or more beads in it
+2 pts	Each bead thrown into a fish net
+2 pts	Having a display that moves mechanically at least 4”
+2 pts	Playing a song
+2pts	Having a display that lights up
+5 pts	Completing the track, in one direction
+10 pts	Completing the track, in both directions (full loop)
-1 pt	Each bead/marshmallow attempted, but left on roadway
-5 pts	Touching any obstacles: barricade, trash bin, building, or power line
-10 pts	Knocking over any obstacles: barricade, trash bin, building, or power line
Disqualification	Damage to the game board, at the Judges discretion. Venturing off of the game board. Touching the robot after hands off. Remotely operating the robot after hands off.

APPENDIX A – Game Board and Objects Specifications

- **Game Board (Overall)**
  - 4ft x 8ft sanded plywood, thickness irrelevant
  - It includes a “roadway” in an L shape flanked with “walls.”
  - The roadway includes a center line, painted white.
  - Note that the roadway, walls, and centerline are all painted -- they are not 3-dimensional structures.
  - Past the walls will be cups for receiving Mardi Grad beads and nets for catching Mardi Gras beads.
  - Start Square: Painted White. A 1’ x 1’ x 1’ start square corresponding to the size restrictions of the robot.
- **Roadway**
  - Length of lane (from centerpoint to centerpoint): 80’’ for leg 1 and 32’’ for leg 2 in an “L” shape
  - Roadway: 16’’ wide, painted black
  - Centerline 1 +/- 0.2”, painted white
- **Barricade:**
  - 2” tall.
- **Trash Bin:**
  - Red Solo brand cups or similar cup with specified dimensions
  - 4 ¼” high, 3 ½” top diameter, 2 ½” bottom diameter
- **Fish Nets**
  - Net handle: Store bought at 13’’, cut down to 5 ½”
  - Net parameters: Store bought at 8’’ diameter, did not modify.
- **Power Line**
  - Supporting Poles are 2’ tall. Placed 2’ apart.
  - Up to 3” of sag in the middle of the line is possible.
- **Trees**
  - Wooden dowel, ⅞” diameter, 2’ tall
  - Tree limb placed at 21”, tree limb extends 6” outward
- **Buildings:**
  - Easy fold box U-Line or similar box with specified dimensions.
  - 11 ⅛” height x 8 ¾” width x 4" depth

APPENDIX B – Building Material Recommendation

- **Game Board**
  - 4ft x 8ft sanded plywood, thickness irrelevant
  - **For example:**
    - https://www.homedepot.com/p/1-4-in-x-4-ft-x-8-ft-BC-Sanded-Pine-Plywood-235552/100063669
    - https://www.lowes.com/pd/Plytanium-11-32-CAT-PS1-09-Square-Structural-Plywood-Pine-Application-as-4-x-8/3010116
- **Roadway Paint**
  - Road Surface - Black
    - Spec. TBD
  - Road Center Line - White
    - Spec. TBD
- **Barricade**
  - Spec. TBD
- **Trash Bin**
  - Red Solo Brand cups
  - **For Example:**
    - https://www.walmart.com/ip/SOLO-PLASTIC-CUP-RED-16oz-12-pk/474051242
- **Fish Nets**
  - Fishing bait nets, of net diameter 8”
  - Preferably with a handle that can be easily modified.
  - **For Example:**
    - Frabill Fishing Bait net, available at walmart.
    - https://www.walmart.com/ip/Frabill-Baitwell-Landing-Vinyl-on-Fishing-Net-Wooden-Handle-with-Super-soft-1-Vinylon-Mesh/16494432
- **Beads**
  - Plastic beaded bracelets, 2.5” - 3” diameter
  - **For Example:**
    - https://www.orientaltrading.com/plastic-beaded-bracelet-sets-a2-13708822.fltr

Continued on the next page…

- **Power Line**

- Support Poles
  - Wooden dowel, 1¼" diameter
  - **For Example:**
    - https://www.homedepot.com/p/6420U-1-1-4-in-x-1-1-4-in-x-48-in-Hardwood-Round-Dowel-10001811/203334072
- Line itself
  - Rope, type irrelevant

- **Trees**
  - Tree Base
    - Wooden Dowel, 7/8ths diameter
    - **For Example:**
      - https://www.homedepot.com/p/6414U-7-8-in-x-7-8-in-x-48-in-Hardwood-Round-Dowel-10001807/203334067
  - Tree Branches
    - 6" zinc plated steel peg board hook
    - **For Example:**
    - https://www.homedepot.com/p/Everbilt-6-in-Zinc-Plated-Steel-Single-Straight-Peg-Hook-1-4-in-Peg-18035/202305520
- **Buildings**
  - Cardboard box, 11 ⅛" x 8 ¾" x 4"
  - **For Example:**
    - https://www.uline.com/Product/Detail/S-1614/Easy-Fold-Mailers/11-1-8-x-8-3-4-x-4-Kraft-Easy-Fold-Mailers
- **Marshmallows**
  - "Large" approximately 1" - 2" marshmallows
  - **For Example:**
    - https://www.walmart.com/ip/Campfire-Giant-Roasters-Premium-Quality-Marshmallows-24-oz/51923014
- **Periphery / Misc.**
  - Painter's tape, 0.94" to paint the roadway lines
  - Wood screws, #8 x 1 ½, as needed. (For example, can be used to hold nets in place.)

APPENDIX C – Construction Recommendations

Construction recommendations to be added as necessary for clarification purposes. See the following images for preliminary construction photos from the Hardware Competition Committee. Please be mindful that photos are not precise and the board may be incomplete in progress photos.

APPENDIX D – Parts List

Quantity	Item
1 Sheet	4’ x 8’ sanded plywood
TBD	Black Paint
TBD	White Paint
1 small package	Red Solo Cups
3	Fishing Bait Nets
1 package	Plastic Beaded Bracelets
1	1 1/4th Dowel
1	7/8th Dowel
2	Peg Board Hook
TBD	Cardboard Box
1 package*	Marshmallows
1 roll	0.94” Painter’s Tape
1 box	#8 x 1 ½ Wood Screws

**Note marshmallows may need replacing, depending on your environment.*

APPENDIX E - Rule Changes/Clarifications

- **Q - Page 4 of the rules states that the start and end squares will be determined randomly, however the board layout on Page 9 only calls out one start square. Where will the second square be placed?**
    - **A -** *The start square on page 9 is correct. The starting square will be the "end square" after the robot traverses the track and heads back to the starting square. There will not be two starting squares and they won't be randomized. The starting square is the one on page 9.*

- **Q - As to removal of the marshmallows, how far must they be from the track to count as removed? Would it count as removal if the robot were to collect and carry the marshmallows?**
    - **A -** *The marshmallows represent guiding someone off the street to the sidewalk. There will be "alleyways" where the robot must push the marshmallow into for the points to count. These "alley ways" will be randomized.*

- **Q - The rules state that the power line will be randomly placed but the drawing of the game board also calls out a 40" distance from the bottom of the board to the power line. Does this mean that the power line will not be randomized or is the 40" dimension misleading?**
    - **A** *- The power pole will be set at 40" from the bottom (middle of longest part of track) The drawing of the power pole on the game board is accurate.*

- **Q -The rules state that there will be "alleyways" placed in the barricades, how many alleyways will there be?**
    - **A -** *There will be 4 alleyways, with only two of them "open" for the robot run. This means 2 of the 4 will be randomly picked to be opened. The only specifics I will provide is that the alleyways will NOT be within 4 inches of each power pole. (Along the barricade line)*

- **Q - How wide will the alleyways be?**
    - **A -** *A two inch minimum.*

- **Q - Is there any clarification on what "push" means for the marshmallow (i.e. can we pick it up or are we limited to keeping the marshmallow on the ground)?**
    - **A -** *Robot must push/nudge the marshmallow. The marshmallow must stay on the ground.*

- **Q - It states that "obstacles will be placed on the board by the judges", does that mean that there are obstacles in the road?**
    - **A -** *The only obstacle that will be in the road will be the marshmallow. All other obstacles will either be hanging above or on the outside of the barricade.*