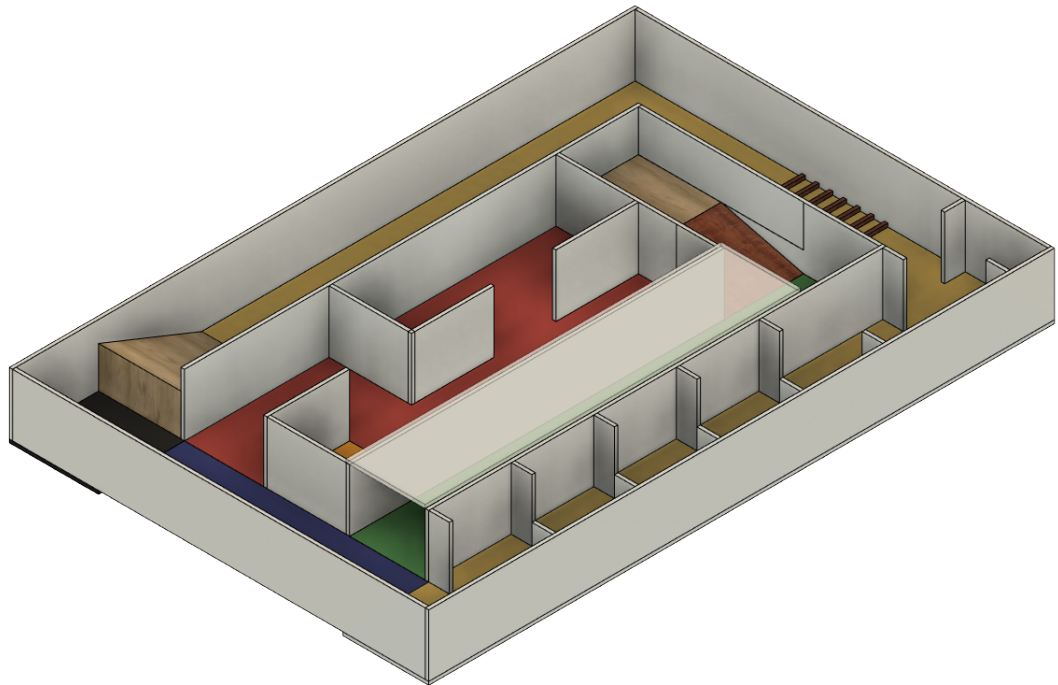


Student Tele-Operated Robotics Mission

April 13th, 2024

The University of Oklahoma
Sooner Competitive Robotics

Version 1.0
Updated October 2, 2023



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1 Competition Overview

1.1 Motivation

The Student Tele-Operated Robotics Mission is a interscholastic robotics competition for university students. Students will build a tele-operated robot that is capable of navigation, investigation, and interaction. The robot's operator will be in a physically separate location from the robot and may only communicate with the robot over a provided WiFi link. Choosing sensors and displaying collected data to the driver in clever ways are key outcomes.

The goal of the first STORM competition is to be accessible and available to all interested university-level students. Robots built for this challenge should not be expensive or require a lot of robotics background. All tasks can be accomplished with relatively cheap off-the-shelf components available online or in maker stores. To achieve the best scores, teams must creatively integrate all the components to create an efficient and reliable robot.

This is the first year of what we hope becomes an annual competition! As we are still experimenting with how best to run this challenge, these rules will likely be modified for edge cases and extra details as the competition date nears. All changes will be noted with a new version number and will be announced in the competition Discord available at <https://ou.edu/scr/storm/>. If you spot any errors or have any questions, please let us know!

1.2 Background

The STORM program is a hypothetical initiative tasked with designing, developing, and deploying tele-operated robots to sites that have seen severe storms. The robot must be able to navigate the dangerous setting and assess the need for a subsequent human visit.

1.3 Registration

Registration is free and can be completed at <https://ou.edu/scr/storm/>

2 Tasks

The STORM 2024 competition consists of several tasks, each awarding points to the Team upon completion. Some tasks may include sub-tasks that also contribute points.

2.1 Task 1: Survey the Points of Interest

The Robot starts at the Start Zone. When the Robot enters each of the following zones for the first time, the Team earns **10 points**. The zones are:

- Payload Zone
- Hazardous Zone
- Sprint Zone

To earn points for a Zone, the entirety of the Robot must enter the Zone, represented by solid tape or flooring change.

2.2 Task 2: Collect the Payloads

The Payload Zone contains ten 2-inch cube Payloads. Two of the Payloads will be made of ferromagnetic material (such as iron or steel) while the rest are entirely non-metallic (such as plastic or wood). All Payloads are visually indistinguishable. You may only **possess** one Payload at a time (see **Penalties**). Points are earned by completing these sub-tasks:

- **10 points** for **possession** of *any* Payload for the first time.
- **10 points** for moving *any* Payload to the Main Site for the first time.
- **20 points** for moving *both* metallic Payloads to the Main Site.

2.3 Task 3: Navigate the Environment

The Hazardous Zone consists of a tunnel that extends from Main Site to the base of the Hazardous Zone ramp. Inside the tunnel are scattered obstacles that are movable. An AprilTag is visible at the end of the Hazardous Zone at the top of the ramp. The AprilTag ID changes each Run. Points are awarded for these sub-tasks:

- **10 points** for Robot reaching the base of the Hazardous Zone ramp.
- **10 points** for Robot reaching the top of the Hazardous Zone ramp.
- **20 points** for displaying the ID of the AprilTag

The obstacles may be any object, but each will weigh no more than 2 lbs and be no larger than 8 inches in any dimension.

2.4 Task 4: Endurance Run

The Sprint Zone path has slalom walls, 90-degree turns, speedbumps, a runway, and ramp. Make sure to note the **Penalties** for touching and knocking over walls. Points are awarded for these sub-tasks:

- **20 points** for Robot reaching base of sprint ramp.

2.5 Scoring Summary

Scoring table	
Criteria	Max Points
<i>Collect the Payloads</i>	
Entering Payload Zone	10
Possession of a Payload	10
Capturing any Payload	10
Capturing both metallic Payloads	20
<i>Navigate the Environment</i>	
Entering Hazardous Zone	10
Exit the Tunnel	10
Climb the Ramp	10
Scan and Display AprilTag ID	20
<i>Endurance Run</i>	
Entering Sprint Zone	10
Reaching the Sprint Ramp	20
Max Points	140

2.6 Penalties

- **-1 point** for each instance of contact with a wall.
- **-10 points** for maintaining contact with a wall for over 10 seconds and **End of Run**
- **-10 points** for knocking over a wall and **End of Run**
- **-10 points** for simultaneous **possession** of two or more Payloads at once. This penalty is enforced only on the first occurrence of each Run.

3 Rules

The following rules should be followed as interpreted rather than as strictly written. Do **not** attempt to circumvent rules regarding safety.

3.1 Robot Requirements

While these requirements enforce a basic level of safety, we strongly encourage all teams to consider safety in the design of their robot.

1. Robots must be ground vehicles. A ground vehicle is defined as a robot that maintains direct contact with the ground.
2. Robots must be battery powered.
3. Robots must stay as one object. Robots may not shoot projectiles or drop pieces.
4. Robots may only externally communicate using the provided WiFi network.

3.2 During a Run

1. If any of the following rules are broken, there is an automatic **End of Run** and the Run is nullified.
2. Any team members in the Control Room may not communicate with anyone outside the Control Room while a run is in-progress. This includes the time during setup.
3. No devices to control the robot should be in a team members possession during a run, unless they are the Operator in the Control Room.
4. Teams have an allotted 10 minute period to setup and run their robot. At the end of the 10 minute period, the run ends. There is no penalty for time expiring.
5. Each robot must navigate the course by remaining inside the walls. Robot may not move over a wall.
6. At the discretion of the Captain, the team may take a **10 point** penalty to move the robot to any place on the course. If this rule is used, the robot may no longer earn future points for movement, reaching, entering, or exiting locations.
7. If the Captain would like to forego the rest of the allotted time for a run, they can request an **End of Run**.

3.3 Event

1. The Captain is responsible for all official communication with the Judges.
2. Teams will be given a at least two official runs. More runs may be allowed pending the amount of teams waiting to run the course.
3. Teams may use a field to practice per judge approval when no official runs are scheduled or occurring.

4 Design Competition

In addition to the main competition, there will be a Design Competition. Participation in the Design Competition is mandatory to compete in the STORM challenge.

The Design Competition requires the submission of a Technical Document for each robot. Each Technical Document should describe design, implementation, and performance of the associated robot.

Each Technical Document should address the following topics, but may include more information to provide a complete picture of the robot.

- Team Organization and Team Members
- High-level block diagram(s) of the robot
- Mechanical Design
 - Drive Configuration
 - Object Manipulation
 - Use of Computer-Aided Design (CAD) or Simulation
- Electrical Design
 - Single-board computers, microprocessors, FPGAs, etc.
 - Sensors
 - Power Delivery
- Software Design and Driver Interface
 - Driver Interface
 - Networking
- Safety and Reliability
- Bill of Materials

4.1 Design Competition Scoring

Criteria	Maximum Points
Description of Team and Robot	20
Description of Mechanical Design	40
Description of Electrical Design	40
Description of Software Design	40
Description of User Operation	20
Novelty	20
Organization and Style	20
TOTAL POINTS	200

4.2 Design Competition Submission

Technical Documents are to be submitted no later than two weeks before the competition date. Technical Documents are to be no longer than 5 pages not including title pages and appendices. Technical Documents are to be submitted in PDF format.

Technical Documents are to be submitted via email, along with any questions, to scr@ou.edu

5 Awards

Awards will be given to the top three teams in each of the following categories:

- Robot Competition
- Design Competition

The Robot Competition ranking is determined by the highest amount of points earned by a Team during any Run. Ties are broken by time taken on the course.

The Design Competition ranking is determined by the Design Competition scores. Ties are broken using the Robot Competition ranking.

6 Appendix

6.1 Glossary

- A **Team** is a registered entity. Each Team has one Robot, a Captain, an Operator, and any other Team Members. A Team is associated with an University, but an University may have multiple Teams.
- A **Team Member** is a student on a Team.
- The **Captain** is a Team Member responsible for being the official point of contact for their Team.
- The **Operator** is a Team Member responsible for being the official point of contact in the Control Room during a run.
- The **Control Room** is where the Operator and any other Team Members are located during Runs. The Control Room provides WiFi and Ethernet options for communication with the Robot. The control room will be separate from the main competition room without any view of the robot.
- An **End of Run** ends a Run regardless of remaining time left. There is no penalty unless specified.
- **Possession** of a Payload is defined as a robot continuously moving and contacting a Payload for at least one second.

6.2 Networking Information

Prior to the event, Teams will be given the SSID information to connect to the wireless Access Points (AP) at the competition. One SSID will be for the Robots to connect to on the field and one SSID will be for the Operator and their control equipment (as an alternative to using Ethernet). Teams should be prepared to configure the Robot's wireless settings at the event.

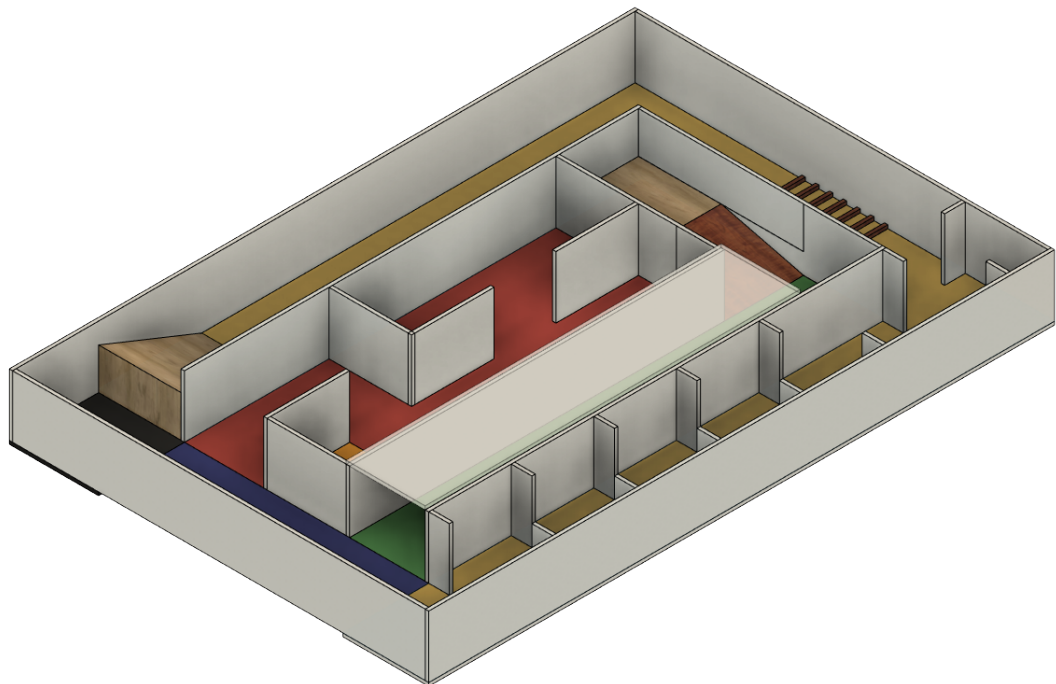
The APs will be on the same subnet (10.10.X.Y) as well as both being internet capable. Therefore, teams can either network their Robot to their control equipment either via LAN or via the internet. More information about using the LAN will be provided prior to the event.

6.3 Scoring Item Details

6.3.1 AprilTags

The AprilTags used on the field will be from the 36H11 family and printed on standard printer paper. The AprilTags will be between 6 and 10 inches wide. Examples may be seen at <https://github.com/AprilRobotics/apriltag-imgs/tree/master/tag36h11> .

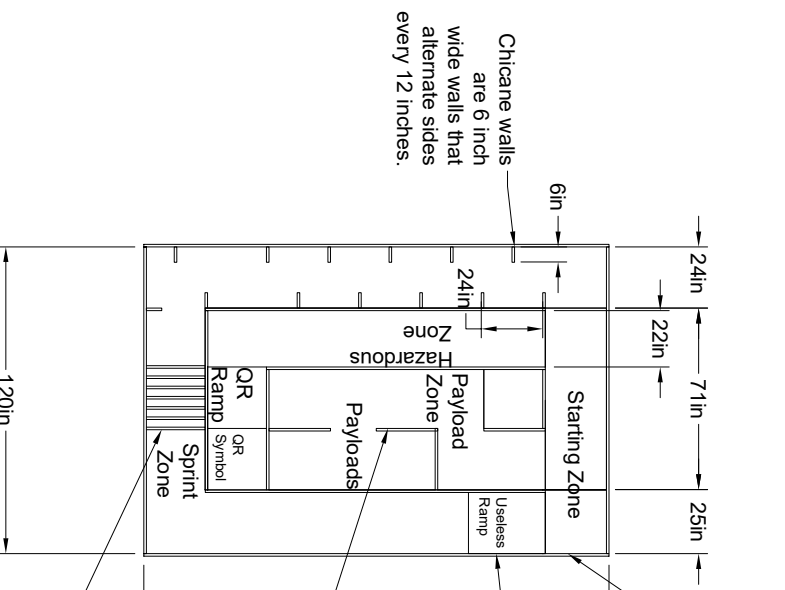
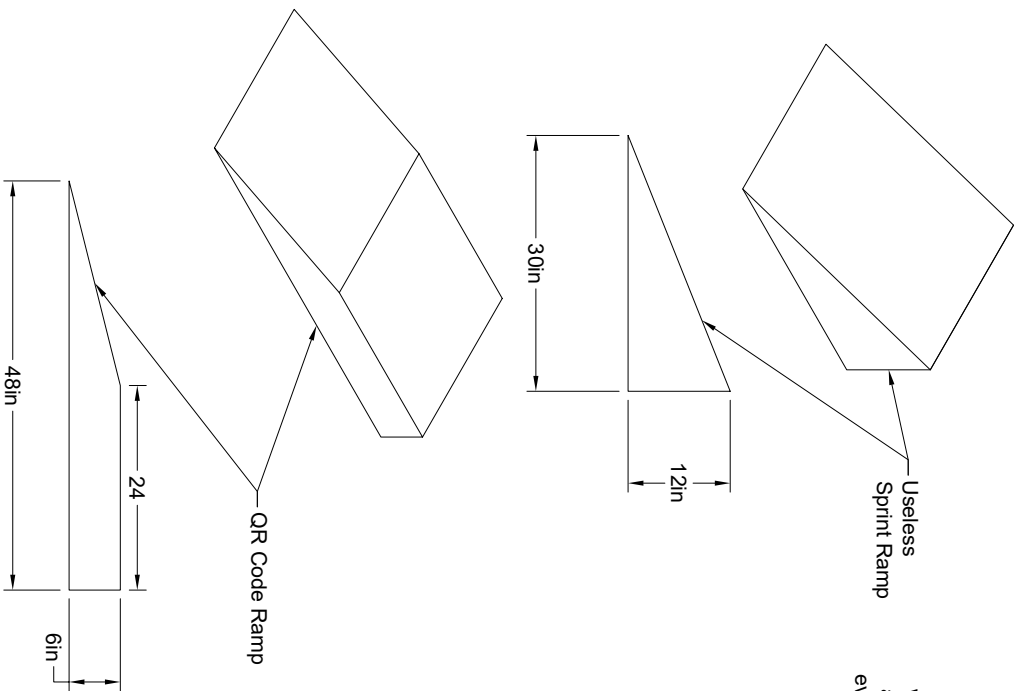
6.4 Field



STORM FIELD

2023

REVISION V3



NOTE: All Walls are made with 1 inch thick pink foam that is 18 inches tall. All gaps will be at least 12 inches wide with most being at least 18 inches. Bumping into walls incurs a point penalty. Knocking over walls will incur an end of run penalty.

The beginning of the ramp is the endzone of the sprint, but you are not required to go over the ramp. Going over the ramp would be faster, but riskier for the robot.

The payload objects will be placed inside of this zone. The two metallic payload objects in this zone are supposed to be transported to the main site / starting zone.

Speed bumps are 1x1x24 inch blocks made of wood or plastic that are placed sporadically in the Sprint zone.

The Harzardous Zone is a tunnel up to the ramp corner. The Tunnel roof is made with 1 inch foam and rests on top of the walls..

