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Matches will take place from 12/8 to 12/10. The final matches will take place on 12/10.

## Game Play

The game is based off multiplayer online battle arena style games. In these styles of games players use virtual avatars to join two teams to fight against each other on a playing field. In our case groups of 3 students will create a robot to act as the avatar. Four robots will be on each team. The objective of the game is to deplete the health of the opposing team's nexus (home base), while protecting your own. You can also deplete the health of opposing robots by hitting them with your weapon. This should not actually damage the robot, but the damage is scored by touching the opposition with your weapon. When a robot's health is gone, that robot is "dead" for a period of time and will be removed from the playing field then respawned back at their home base. Healing and damage will be recorded by judges watching for healing and damage indicators.

The game starts with each team in their home base on either side of the field. Players remotely control their robots on the field to drive around to affect different parts of the field, attack opposing team's robots or nexus. The game ends with the winner being the first team to destroy the other team's nexus.

### Player Teams:

- There are 4 robots per team (e.g. 4v4 competitions).
- Each group of 3 students can be formed by student choice.
- The teaming of the student groups into 4 robot teams will be done by the teaching staff.
- Each group of 3 students will have \$100 dollars from MEAM to spend on their robot to purchase items from pololu, digikey, sparkfun, adafruit, mcmaster, and amazon during periodic, specified combined class purchases.

### Robots:

Each robot has physical capabilities and virtual attributes. The allowed physical capabilities include:

- R1. Moving around the field to different locations.
- R2. Pushing other robots.
- R3. Standing over a healing beacon (robot should indicate when healing light is detected)
- R4. Some visual indication of when a chosen virtual ability is activated. See *Abilities* below.

Each robot maintains a set of two virtual attributes:

- R5. Health points - when health is at 0, the robot is dead.
- R6. Attack Damage (AD) - the amount of damage done when the robot attacks another which is inversely proportional to the robot's weight. See *Damage* below.

Minimum requirements. The robots must:

- R7. Be WiFi controlled.
- R8. Stop when health is depleted
- R9. Start when health is not 0. All robots will start with 0 health in their base.
- R10. Identify light of a specific frequency (from the healing beacon).
- R11. Display health as received from periodic health wifi status messages.

- R12. Clearly indicate the following when alive:
- Team color and member number (which may change between matches)
  - When this robots melee weapon hits something
  - When a healing frequency is detected coming from below.
- R13. Have at least one attack ability.

Constraints. The robots must:

- R14. Fit in 8"x5" plan view area at the start of the match.
- R15. Not physically damage or permanently modify other robots or the playing field.
- Should not be designed to flip other robots.
- R16. Not contain or dispense liquids, flames, combustion, anything potentially dangerous.
- R17. Not separate or intentionally leave parts of itself behind (other than throwing nerf foam ball projectile).
- R18. Cannot produce vertical force while not in contact with the ground.

### Abilities:

All damage abilities have "cooldown" times associated with them. After a damage ability is used, it cannot record damage again until the cooldown time has expired.

- Melee attack (swing a sword or stab a spear or something with limited range)
- Ranged attack (throw a nerf ball (supplied by MEAM510) - this is the only projectile allowed)

Teaching staff will consider allowing other student suggested abilities.

- The damage done by either ranged or melee attack will be the same for each hit.
- The cool down applies to both melee and ranged in the same manner.
- Each hit can only do damage to one opponent.

### Damage:

The amount of damage and the cooldown period for a bot is based on its weight:

- D1. TBD (lower weight, higher damage)  $12 - 2 \times \text{weight}(\text{lbs})$  with a minimum of 1 DPS.

Where DPS stands for damage per second.

- So a 2 lb robot would do 8 damage per second .
  - This could have a cool down period of one second so each hit would remove 8 health points.
  - Or a cooldown period of 3 second in which case each hit would do 24 damage, but would have a longer period of time in between.
  - The damage per hit cannot exceed 25.
- D2. Before the match you must determine what you want your cooldown period to be.
- D3. The cooldown period cannot be less than one second.
- D4. A melee weapon can only record a hit with a small portion. For example, only the sword tip will damage not the whole length of the blade. To register damage the robot must sense the contact and indicate that contact was made, (e.g. by lighting up an LED on the weapon). This will help a judge recognize a hit, though the judge will decide if the hit was valid (e.g. hit an opponent or the ground, within cooldown etc.). Lighting up when hitting the field, or an opponent before the cooldown ends is okay.
- Making this more impressive (visual or audio effects) is encouraged
  - The damaging element must fit within a 1" cube.

**Death timer:**

When a robot's health is reduced to zero, the robot must turn off all LED's and not move (some form of dying animation will be also acceptable). A judge will pick up the robot and place it back in its base location. After the death time has expired, the robot's health will return and it can become active again.

The death time will be 10 seconds plus 10 x (#mins of game time) up to 4 minutes of game time at which point the death timer will remain at 50 seconds. If you fail to stop at the proper time the judge will hold your robot for an additional 15 seconds.

**Healing:**

Recovering health only occurs upon respawn, or while standing over an active healing beacon.

H1. There are multiple healing beacons shining up from the floor, but only a few will be active with the correct frequency. Whether a beacon is active or inactive may change during the course of a match.

H2. To heal, the robot must be able to sense the healing frequency of the active healing beacon.

H3. The robot should show lit white LEDs to indicate it has recognized the healing frequency.

H4. Some inactive beacons may display a false frequency. Lighting the healing indicator improperly will cancel the ability to heal for the rest of the match.

**Health Display and Status Message Packet**

Your robot should be able to receive a UDP packet indicating the health of your bot.

- The packet will be a string of the form "RnnR1R2R3R4BnnB1B2B3B4" where Rnn is the red nexus health, Bnn is the blue nexus health, R# and B# are the red and blue team member healths in decimal.
- The nexus health will be 3 digits and the player health will be 2 digits
- So "4321245789923497743322" would be:

Red Nexus at 432

Blue Nexus at 234

Red 1 at 12

Blue 1 at 97

Red 2 at 45

Blue 2 at 74

Red 3 at 78

Blue 3 at 33

Red 4 at 99

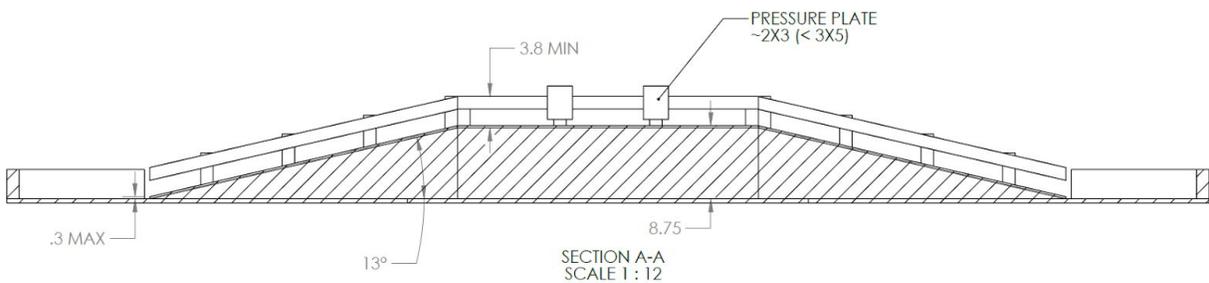
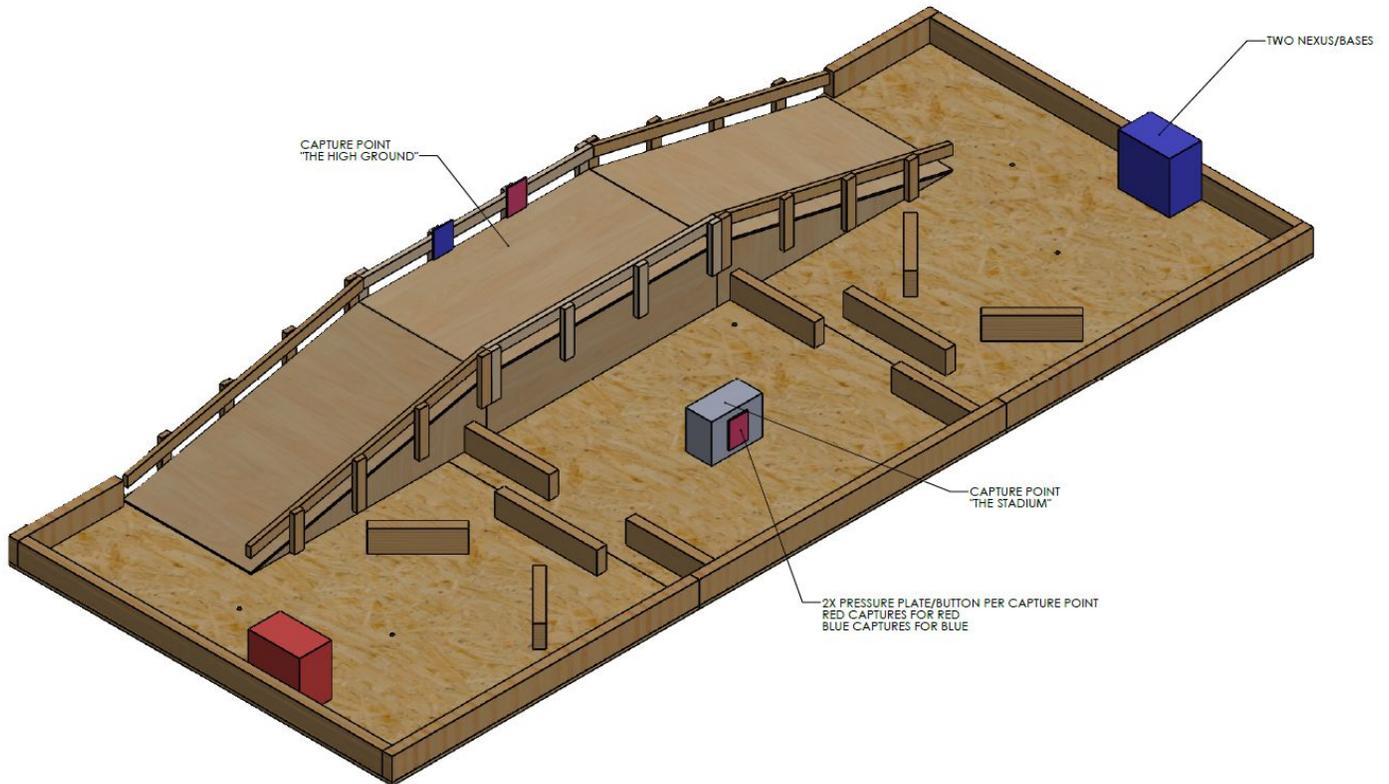
Blue 4 at 22

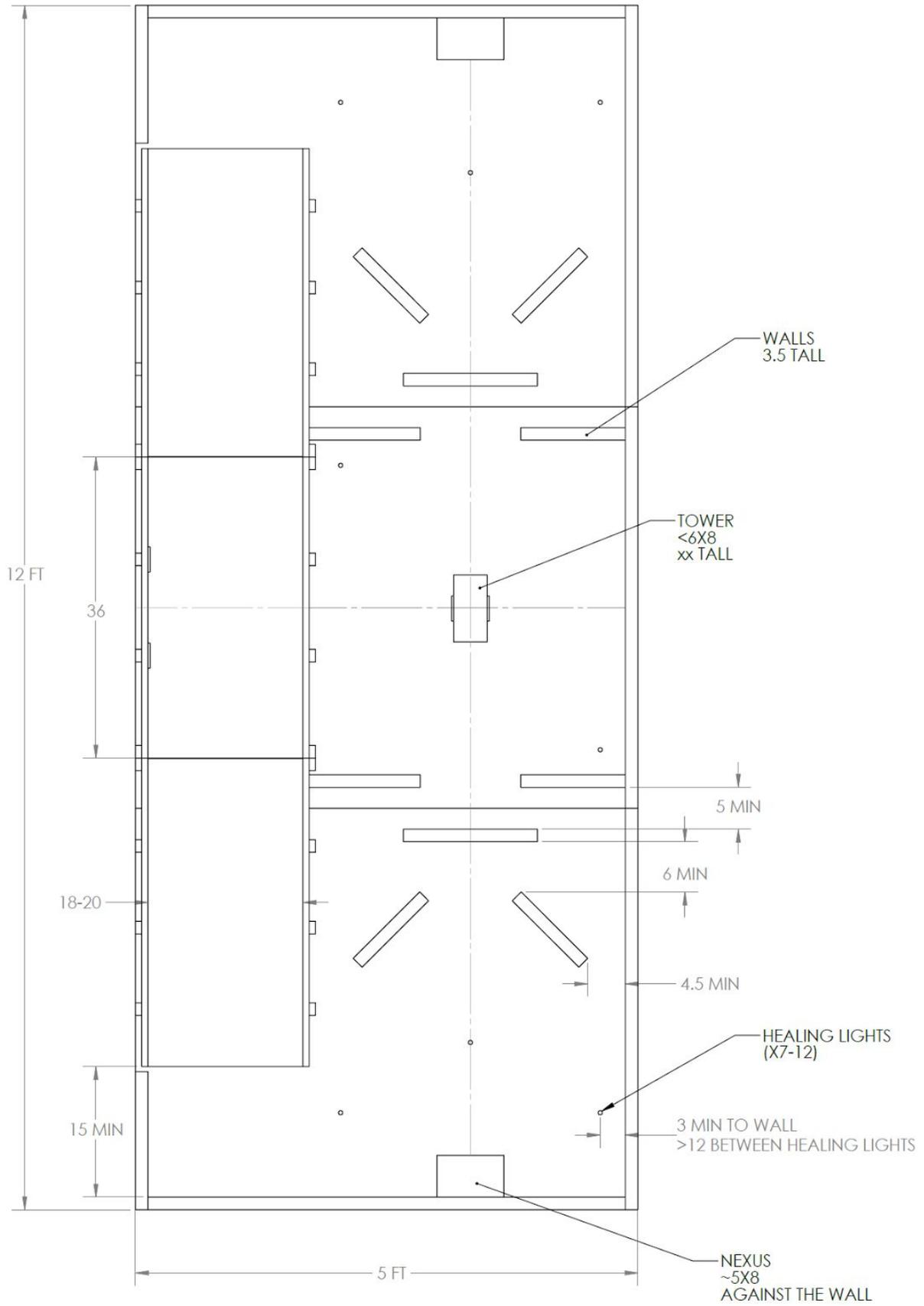
- The current health of your robot should be clearly displayed on a standard green LED bar from GM.

# Field of Play

The field will consist of a high level and a low level structure, each level will have an automated weapons nest, see *Key Features* below. The lower level will have obstacles that must be navigated, dimensions can be seen on the diagram below.

All dimensions are in inches unless otherwise noted.





**Key Features:**

- Nexus - Each team has a nexus with a fixed amount of health. When that health is depleted, that team loses.
  - The nexus has an automatic defense mechanism, each time it is hit, 50% of the damage is reflected back to the robot doing the damage.
- Healing Beacons - These are placed at fixed locations the floor.
  - Active beacons pulse visible light at a specific frequency.
  - Inactive beacons may also pulse but at a different frequency.
  - These will be at least 3 inches from any wall
- Automated Weapon Nests- The playing field has two automated weapon nest objectives each with two buttons, a red and blue button.
  - These objectives are captured by holding the team's color button for 8 seconds without the other button also being pressed. The 8 second timer is reset if the other button is pressed.
  - Once captured the nest will automatically start to damage to the opponent's nexus. It will continue until it is re-captured by other team. The damage from the nest is 4 DPS.

## **ALL RULES AND THE FIELD ARE SUBJECT TO CHANGE.**

Submit a final report including your mechanical and electrical designs with an explanation of the design choices you made. Submit your code, electronic schematics and data sheets of non-standard items that you may have purchased. You should also include a BOM (Bill of Materials), which list the items and quantities used to construct your robot and controller.