CONTENTS

TECHFEST OFFICE
STUDENTS' GYMKHANA, IIT BOMBAY
POWAI, MUMBAI
MAHARASHTRA - 400076

TASK

Design and construct a remote controlled robot capable of fighting a one on one tournament.

DESIGN SPECIFICATIONS

Specifications:
Dimensions and Fabrications:

1. The machine should fit in a box of dimension 800mm x 800mm x 1200 mm (l x b x h) at any given point during the match (considering all weapon movement also). The external device used to control the machine or any external tank is not included in the size constraint.
2. The machine should not exceed 54.45* kg (120 pounds) and should be more than 22.67* kg (50 pounds) of weight including the weight of pneumatic source/tank. All pneumatic tanks/source and batteries should be on board. Only the weight of remote controller will not be counted.
3. A bot can be in a “Cluster Bot” formation. Each bot must meet the requirements described in this problem statement. The total weight of all the bots cannot cross the limits in the above point. The combination of bots must be able to fit in the dimensions given in point 1.

Mobility:
All robots must have easily visible and controlled mobility in order to compete. Methods of mobility include:

1. Rolling (wheels, tracks or the whole robot).
2. Non-wheeled: non-wheeled robots have no rolling elements in contact with the floor and no continuous rolling or cam operated motion in contact with the floor, either directly or via a linkage, but are not true walkers as defined below. Motion is "continuous" if continuous operation of the drive motor(s) produces continuous motion of the robot. Linear-actuated legs and novel non-wheeled drive systems are also allowed under this category.
3. Jumping and hopping is allowed (manually operated). However, the maximum height of any part of the machine should not exceed 6ft during any stage of its jumping/hopping and any damage caused due to this mechanism is a responsibility of the team.

Mobility methods that are NOT allowed:

1. Flying (using airfoil, helium balloons, ornithopters, etc.) is not allowed.
2. Robots should not secure itself on the ring surface by using suction cups, diaphragms, sticky treads, glue or other such devices.

Robot Control Requirements:

1. The robot must be controlled through wireless remote only, while all power supply must be on board only.
2. Control must be exhibited over all of its functions and positions. Although Autonomous functions within the bot are acceptable, the controller must be able to remotely disable or override those functions at any time. Also note that any damage due to this function is a responsibility of the team, and there must compulsorily be a manual emergency stop (E-stop) function that can be

controlled from the radio controller to manually override this autonomous function in case of emergency.

3. There should be binding capability between transmitters and receivers and they must connect between polycarbonate (20mm), metal bars and barriers. The remotes with such facility will only be allowed.
4. The team must have at least four frequency wireless remote control circuit or two dual control circuits which may be interchanged before the start of the race to avoid frequency interference with other teams. The case of any interference in the wireless systems will not be considered for rematch or results.
5. Remote control systems from toys might be used. Remote control systems available in the market may also be used. While nonstandard or self-made remote control systems must first be approved by the organizers.
6. Team should pair up the wireless remote with the machine before putting it into the arena. No extra time will be provided for this once the machines are put inside the arena, and not connecting it prior to that may attract a penalty on the team.

Battery and Power:

1. The machine can be powered electrically only. Use of an IC engine in any form is not allowed. On board batteries must be sealed, immobilized-electrolyte types (such as gel cells, lithium, NiCad, NiMH, or dry cells).
2. The electric voltage between 2 points anywhere in the machine should not be more than 48V DC at any point of time. Participants will have to bring their own converters for standard power supply according to Indian standards. (A detailed document for
3. All efforts must be made to protect battery terminals from a direct short and causing a battery fire, failure to do so will cause direct disqualification.
4. Use of damaged, non-leak proof batteries may lead to disqualification.
5. Special care should be taken to protect the on-board batteries. If judges find that the battery is not properly protected, then team will be disqualified immediately.
6. Change of battery will not be allowed during the match.
7. Only bots with on board batteries are allowed.
8. The supply from the battery to all the weapons and power systems should qualify the following fail-safes:
    a. A manual disconnect (switch) that can be turned off without harming the person doing it, i.e. No body parts or weapons should come in the way of the switch.
    b. Manual emergency stop that can be triggered through the radio controller

It is suggested to have extra battery ready and charged up during competition so that on advancing to next level, you don't have to wait or suffer due to uncharged battery (Refer section "Match Frequency"). If teams don't show up on allotted slot, they will be disqualified.

Pneumatics:

1. Robot can use pressurized non-inflammable gases to actuate pneumatic devices. Maximum allowed outlet nozzle pressure is 12 bar*. The storage tank and pressure regulators used by teams need to be certified and teams using pneumatics are required to produce the Safety and Security letters at the Registration Desk at the venue. Failing to do so will lead to direct disqualification. Also Note that Techfest, IIT Bombay will not be providing mechanism to refill the pneumatic cylinders/containers of maximum pressure more than the limit mentioned above.

2. Participants must be able to indicate the used pressure with integrated or temporarily fitted pressure gauge. Also there should be provision to check the cylinder pressure on the bot.
3. The maximum pressure in cylinder should not exceed the rated pressure at any point of time. All pneumatic components must be rated of at least the value of maximum pressure.
4. You must have a safe way of refilling the system and determining the on board pressure.
5. All pneumatic components on board a robot must be securely mounted. Care must be taken while mounting the pressure vessel and armour to ensure that if ruptured it will not escape the robot. The terms 'pressure vessel, bottle, and source tank' are used interchangeably.
6. Entire pneumatic setup should be on board, no external input (from outside the arena) can be given to the robot for functioning of its pneumatic system.

Hydraulics:

1. Robot can use non-inflammable liquid to actuate hydraulic devices e.g. cylinders.
2. All hydraulic components on-board must be securely mounted. Special care must be taken while mounting pump, accumulator and armour to ensure that if ruptured direct fluid streams will not escape the robot.
3. All hydraulic liquids are required to be non-corrosive and your device should be leak proof.
4. Maximum allowed pressure is 12 bars*.
5. Participant must be able to indicate the used pressure with integrated or temporarily fitted pressure gauge.
6. Entire hydraulic setup should be on board, no external input (from outside the arena) can be given to the robot for functioning of its hydraulic system.

Weapon Systems:

Robots can have any kind of magnetic weapons, cutters, flippers, saws, lifting devices, spinning hammers etc. (if they qualify the criteria mentioned below) as weapons.
Following weapons are exceptions and **cannot** be used:

1. Liquid projectiles (Foam, liquefied gases)
2. Any kind of inflammable liquid.
3. Weapons causing invisible damage (Electrical weapons, RF jamming weapons and others)

Spinning Weapons:

1. The maximum rotational speed of any point on the weapon/body should not exceed 150mph*.
2. Spinning weapons must come to a full stop within 60 seconds of the power being removed using a self-contained braking system.

Spring-loaded or flywheels:

1. Under no circumstances must a large spring be loaded when the robot is out of the arena or testing area.
2. All springs, flywheels, and similar kinetic energy storing devices must fail to a safe position on loss of radio contact or power.

Flame-based:

1. Flame rules may change subject to Infrastructural and Safety limitations.
2. Fuel must exit the robot and be ignited as a gas. It cannot leave the robot in a liquid or gelled form or use oxidizers.
3. Fuel types allowed are propane and butane, the maximum quantity allowed is 16 fl oz.
4. The ignition system must have a remotely operated shut-off that allows the controller to disable it using the radio control system.

COMPETITION RULES AND SPECIFICATIONS

Team Specification:

1. Any team can participate in Robowars, Techfest. A team may consist of a maximum of 6 participants. These participants can be from same or different institutes.
2. Team Name: Every team must have a name which must be unique. Techfest reserves the right to reject entries from any Team whose name it deems inappropriate, offensive or conflicting. Organizers must be notified if a Team's name has been changed.
3. Team Representative: Each team must specify their Team Representative (Leader) at the time of registration on the website. All important communications between Techfest and the registered teams will be done through their Team Representative. The Team representative must submit valid contact details (phone no., email ID etc.) at the time of registration.

NOTE: During any kind of conversation, registration, communication, mails or submissions the team must identify themselves by their Team ID only provided at the time of registration and not by your team name. Please do not use your team name as your identification in any kind of communication with us. Follow this rule very strictly.

Registration:

Teams using pneumatics or hydraulics will have to send a safety letter containing targeted maximum pressure and type of equipment to be used, signed by any faculty in- charge/Lab in-charge or a testing lab/company dealing in this field, on their official letterhead. The last date for registration and submission of safety letters is 15th October, 2017.
Also, since there will be updates to the Problem Statement (See the closing section “Important Note”), Techfest will put efforts into informing the registrants about updates through email/SMS.

Submission of Abstract:

1. *For Participants in Indian subcontinent^:*
   Participants have to submit a portfolio of their machine, consisting of a written abstract and a video of the working model before the competition. This portfolio will be used to seed teams for the competition. Only the shortlisted teams will be eligible to participate in 'Robowars' at Techfest 2017-18. The teams can do an online submission, mailing us the soft copy of abstract (PDF format) and a video of your robot at krish@techfest.org with subject "Robowars Team ID”. Offline submissions won't be entertained. Last date for portfolio submission is 15th October 2017.
2. *For Participants from outside Indian subcontinent^:*
   Apart from the regular written and video abstract (to be submitted before 15th October, 2017), teams have to submit an initial additional portfolio of their machine, consisting of a written abstract and complete plan for different parts, weapons etc. This will be used in determining which teams will be provided the reimbursement according the structure mentioned at techfest.org/robowars. The teams have to do an online submission, mailing us the soft copy of abstract (PDF format) at krish@techfest.org with subject "Reimbursement | Robowars Team ID”. Offline submissions won't be entertained. Last date for portfolio submission is 30th September 2017.

^Indian subcontinent: Bangladesh, Bhutan, India, Maldives, Nepal, Pakistan and Sri Lanka.

Abstract Details:

(This section pertains to the general abstract to be submitted by every team, not the initial abstract for teams outside Indian subcontinent)

Written Abstract:

1. The weapon systems and power supply method should be explained in detail, along with proper diagrams. Picture(s) showing these should be attached.
2. Functioning of wireless remote and the frequency or any other wireless module used for wireless remote must be explained in detail.
3. Description of any unusual advantageous mechanism used. The specifications of all the components used, including motors, suspension springs, remote controller, wires, battery etc. have to be mentioned.
4. You can email the portfolio minus the video and send the video later. This will make sure that at least the abstract part of your portfolio reaches us before the deadline. An email will be sent to the team leader confirming the receipt of the entry. Each team is allowed to make online submission only by email. In case of multiple submissions, only the first submission will be used for judging purposes.
5. All submission must be made online before the deadline.
6. Soft copy of the permission regarding pneumatics and hydraulics capacity must be mailed to before deadline. Hard Copy of the permission must be brought during the competition. Teams failing to do any of this (soft copy submission and hard copy presence), will not be allowed to participate.
7. Deadline for submission of abstract for Robowars is 15th October 2017. Further instructions for abstract submission will be sent by mail to registered participants only.

Video Abstract:

1. The video should be of at least 1 minute with the unedited clip showing the machine performance to the fullest. All destructive mechanism(s) being used must be shown working. We may demand another clip on a later stage to the participants who qualify Round 1. Instructions for the same will be sent by mail to such participants. Last date for submission for first video is 15th October 2017.
2. It is not necessary to explain the mechanisms in the video. All portfolios will be used strictly for seeding purposes. The elimination procedure will be objective and the evaluation of every participant will be published on the website. Techfest assures total privacy of the matter submitted to us. The portfolio of your machine will be helpful in future as an evidence of your hard-work along with determining your position for the competition. Hence, please pay adequate attention to it.
3. All submission must be made online before the deadline.

NOTE: Please note that this video abstract will not be the sole criteria for selection of your robot to perform at Robowars, Techfest 2017-18. Judges will go very thoroughly over the video and written abstracts both and then shortlist the robots which would be allowed to perform in the competition here at Techfest. The portfolio is meant to assess the efforts put in by participants. Thus even if you are not able to meet the requirements asked in the portfolio, please send us the portfolios based on the current state of your machine before the deadline. That means even if your machine is incomplete, please send the portfolios anyway, instead of not sending them or sending them late.

Match Duration and Type:

Matches shall be 3 minutes of active fight time exclusive of any time-outs. Hence, it is not binding but advisable to keep battery capacity, power usage and machine defenses such that it can sustain a 3 minute fight.
The matches can be of the following types:

1. *Match:* A regular 1-on-1 combat between 2 robots
2. *Resurrection Match:* A combat involving robots, each of which has lost at least one match previously
3. *Rumble:* A combat between more than 2 robots simultaneously

A detailed document of rules regarding the format and rules to be followed during the event days shall be uploaded later, and it shall be intimated to participants.

Match Frequency:
A team is allowed 30 minutes to prepare for the next match. This time is calculated from the time the robot leaves the post-match staging area. If the team fails to return, with the robots ready, to the pre-match staging area when called after the allotted time, the team may be forced to forfeit. It is recommended that any routine maintenance (i.e. battery charging) should be capable of being performed well within this time period, or backup should be kept. In extreme cases the 30 minute time period may be lengthened at the discretion of the event organizers.

Criteria for victory:

1. A robot is declared victorious if its opponent is immobilized.
2. A robot will be declared immobile if it cannot display linear motion of at least one inch in a timed period of 10 seconds. A bot with one side of its drivetrain disabled will not be counted out if it can demonstrate some degree of controlled movement. In case both the robots remain mobile after the end of the round then the winner will be decided subjectively.
3. A robot that is deemed unsafe by the judges after the match has begun will be disqualified and therefore declared the loser. The match will be immediately halted and the opponent will be awarded a win.
4. If a robot is thrown out of the arena the match will stop immediately, and the robot still inside the arena will automatically be declared as the winner.
5. Robots cannot win by pinning or lifting their opponents. Organizers will allow pinning or lifting for a maximum of 20 seconds per pin/lift then the attacker robot will be instructed to release the opponent. If, after being instructed to do so, the attacker is able to release but does not, their robot may be disqualified. If two or more robots become entangled or a crushing or gripping weapon is employed and becomes trapped within another robot, then the competitors should make the timekeeper aware, the fight should be stopped and the robots separated by the safest means.
6. Points will be given on the basis of aggression, damage, control and strategy.
    a. *Aggression*: Aggression is judged by the frequency, severity, boldness and effectiveness of attacks deliberately initiated by the robot against its opponent. If a robot appears to have accidentally attacked an opponent, that act will not be considered Aggression.
    b. *Control*: Control means a robot is able to attack an opponent at its weakest point, use its Weapons in the most effective way, and minimize the damage caused by the opponent or its weapons.
    c. *Damage*: Through deliberate action, a robot either directly or indirectly reduces the functionality, effectiveness or defensibility of an opponent. Damage is not

considered relevant if a robot inadvertently harms itself. Also, if a pressure vessel or a rapidly spinning device on a robot fragments, any damage to the opponent will not be considered "deliberate".

d. *Strategy*: The robot exhibits a combat plan that exploits the robot's strengths against the weaknesses of its opponent. Strategy is also defined as a robot exhibiting a deliberate defence plan that guards its weaknesses against the strengths of the opponent.

NOTE: Qualification of a robot to next level is subjective and totally on the decision of the judges. A robot winning in a round against its opponent doesn't guarantee its entrance into the next round. If the judges found the winner robot incompetent to enter into the next round, it may get disqualified. Judges can disqualify both the robots of a match from advancing to the next round. All the decisions taken by the judge will be final and binding to all. Any queries afterwards will not be entertained.

Event Specific Terminology:

1. *Disabled*: A robot is not functioning correctly due to either an internal malfunction, or contact with the opposing robot or Arena Hazard.
2. Disqualification: A Robot is no longer permitted to compete in the current Robowars Tournament.
3. *Immobilized*: In Judge's opinion, a robot is not responsive for a specified period of time.
4. *Knockout*: Occurs when the attack or deliberate actions of one robot causes its opponent to become immobilized.
5. *Lifting*: Occurs when one robot controls an opponent's translational motion by lifting the drive mechanism of the opponent off of the Arena floor.
6. *No Contact*: Occurs when neither robot makes contact with each other for a specified period of time.
7. *Pinning*: Occurs when one robot, through sheer force, holds an opponent stationary in order to immobilize it.
8. *Radio Interference*: Refers to the situation where at least one robot becomes non-Responsive or non-controllable due to the effect of the other robot's remote-control signal.
9. *Non-Responsive*: In a Referee's opinion, the robot cannot display some kind of controlled translational movement along the Arena floor.
10. *Restart*: Occurs after a Fault or a Timeout has been declared and the competing robots are ready to continue.
11. *Stuck*: A robot is hung-up on a part of the Arena, an Arena Hazard or an opponent, such that it is effectively non-responsive.
12. *Tap-Out*: Occurs when a Robot's Operators decide that they no longer want to continue the Match, and concede the win to the opposing Team.
13. *Technical Knockout*: Occurs when a robot wins due to immobilization of its opponent even though, in the Judges' opinion, no action of the winning robot caused the opponent's immobilization.
14. *Timeout*: A temporary halting of a Match. Timeouts are usually called to separate robots, but can be called for other reasons as well.

Certificate Policy:

1. Certificate of Excellence will be given to all the winners.

2. Certificates of Participation will be given to all the teams who qualify first round of the competition.
3. The teams which get disqualified due to disobeying any of the competition rules will not be considered for the certificate.
4. Prizes worth INR 10,00,000 to be won along with prizes for best designs, engineering, weapon, reimbursement for selected teams outside Indian subcontinent and other subjective criterion (subject to discretion of judges), in ratio of 1:4 for other prizes to selected (outside Indian subcontinent) team reimbursements.

Safety Rules:

Compliance with all event rules is mandatory. It is expected that competitors stay within the rules and procedures of their own accord and do not require constant policing.

1. Special care should be taken to protect the on-board batteries and pneumatics, robot without proper protection will not be allowed to compete.
2. If you have a robot or weapon design that does not fit in this ruleset (even having some elements that are not mentioned as allowed/disallowed in this ruleset) or is someway ambiguous, please contact Techfest, IIT Bombay at the earliest. Safe innovation is always encouraged, but surprising the organizers with your brilliant exploitation of a loophole may cause your robot to be disqualified before it even competes.
3. Each event has safety inspections. Your team will be allowed to compete at the sole discretion of Techfest authorities, to whom as a builder you are obligated to disclose all operating principles and potential dangers to the inspection staff.
4. Proper activation and deactivation of robots is critical. Robots must only be activated in the arena, testing areas, or with expressed consent of the event coordinators.
5. All weapons must have a safety cover on any sharp edges.
6. All participants build and operate robots at their own risk. Combat robotics is inherently dangerous. There is no amount of regulation that can encompass all the dangers involved. Please take care to not hurt yourself or others when building, testing and competing. Any kind of activity (repairing, battery handling, pneumatics systems etc.) which may cause damage to the surroundings during the stay of the teams in the competition area should not be carried out without the consent of organizers. Not following this rule may result in disqualification.
7. All the resources provided at the time of competition from the organizers should be strictly used only after the consent of the organizers.
8. Once the robots have entered into the arena, no team member can enter into the arena at any point of time. In case if a fight has to be halted in between and some changes have to be done in the arena or condition on the robot(s), it will be done by organizers only.

Arena Specifications:

Safety Precautions:

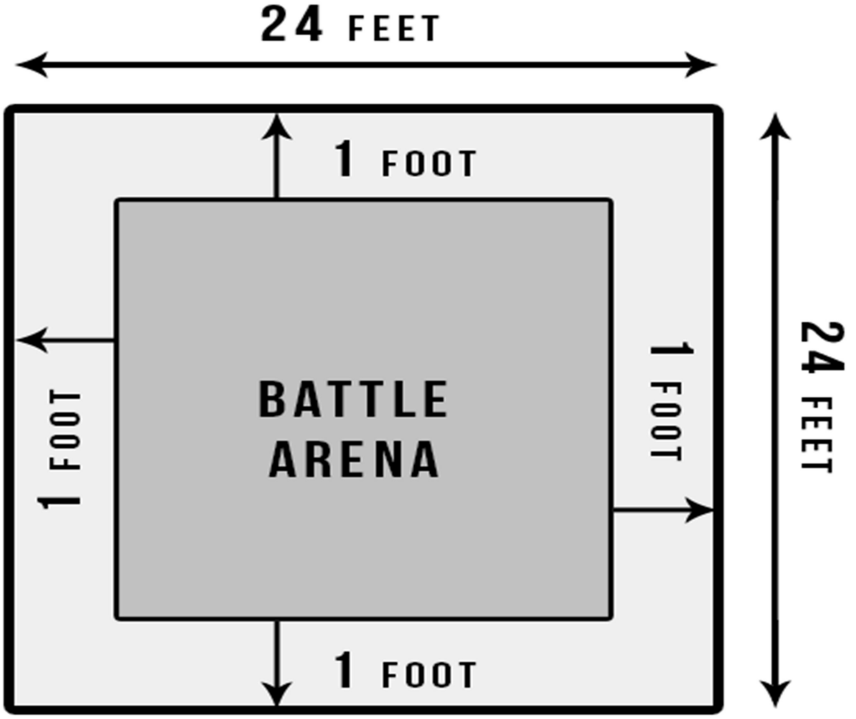
The battle area available to the robots to move in, during the match, shall be 1ft inside the polycarbonate walls, to prevent direct impact.

The arena shall be protected by bulletproof polycarbonate walls of 12mm* thickness at four sides (excluding the top). The top shall be protected by 6mm bulletproof polycarbonate sheet.

Arena Diagram:

The out-to-out dimension of the arena will be 24ft* x 24ft* x 12ft* (l x b x h).

**These figures/parameters are subject to change. The maximum pressure limit may be upgraded depending on the equipments available. Arena size is also subject to the infrastructure. Polycarbonate thickness may be increased. They will be conveyed through updates to this document, as per the "Important Note" below.*



Important Note:
These rules may change any time, even without explicit notification to teams. However the document uploaded here is to be followed as the latest problem statement for all the rules and design specifications. Any change can be observed by the name of the document which will contain a higher version (v1.0 etc) if updated. The Teams acknowledge that is is there responsibility to read, understand and abide by these rules and Techfest, IIT Bombay reserves the right to prevent any team from competing at any time for any reason (including but not limited to the reasons specified elsewhere in this document). However, we shall inform all the registrants in case an updated version comes up (all the registrant till date of revision).

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