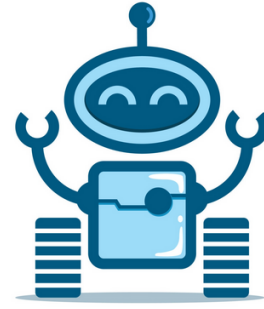




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# EE375L/CE331L Microcontrollers and Interfacing Lab

## ROBOWARS: Project Kickoff

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# 1 Introduction

Theme of the project for the course of Microcontrollers and Interfacing is Robowars, where group of students will design and develop an efficient, reliable and robust robot with attack and defense mechanisms to fight against the opponent robot in a provided arena. The project will be a group work, spread out through the entire semester with milestones, mentioned later in document. The final evaluation will be in the form of a competition amongst the groups, on point based grading, and the best group would be provided with a chance to improve their design, and potentially target national competitions. The project will also familiarize the students with advancements and flavors from high performance computing, networks, computer vision and power electronics, and will prepare students for their capstone projects.

## 1.1 Group Formation

- A maximum of 3 members can be in a group with at least 1 student from EE background, or an EE major.
- The group has to be made within the same Lab section i.e. students from T1 cannot form a group with students from T2.
- The group has to devise a team tag for themselves i.e. Terminator, Delta, Wall-E, etc.
- The members and tag for group has to be finalized by the third week of semester.

# 2 Robot Requirements

Following section covers the in-depth design specifications for mechanical structure and technical requirements, of the robot, that must adhere as per the competition guidelines.

## 2.1 Robot Operations

The robot should be designed with purpose of attack and defense against other opponent robot while ensuring it doesn't use any harmful substance, tools and techniques that may prove to be hazardous, fatal or fragile to people around or the arena itself. At a time, only two robots are allowed to operate inside the arena.

## 2.2 Computational Requirements

Robot is required to use the TivaC Launchpad as a microcontroller for purpose of control, navigation, sensor interfacing, and computation for algorithms. Groups are free to use either Energia or Keil for programming purposes. Additionally, students can use other microcontrollers such as Arduino for support purpose only. The main operations of Robot, however, must be programmed on TivaC Launchpad. In case additional microcontroller is used, the students are required to justify their usage.

## 2.3 Structural Requirements

The robot must include following three main structural requirements in terms of mobility, attack and defense:

1. The robot must be mobile such that it can move forward, backward, left, right and is able to rotate when necessary.
2. The robot must include at least one or more attack mechanism such as punching, kicking, tackling, grasping, flipping etc. Students can come up with their own attack mechanism as long as it includes aggression against the opponent robot.
3. The robot must include at least one or more defense mechanism in terms of shield, blocking, cover etc. Again, the students can devise their own defense mechanism as long as it avoids damage from the opponent robot.

## 2.4 Robot Dimensions

The robot can be built on the provided chassis/base as shown in Fig. 1, however, students can use their own chassis or base on the condition that the dimensions must stay same or lesser than the ones provided in Fig. 1. All the sensors must be contained within these dimensions. The additional hardware for attack and defense, however can exceed the area of the chassis itself, but no more than 5cm on each side. There is no particular restriction on height or weight of the robot but it should be kept in accordance with efficiency of robot's movement and mobility.

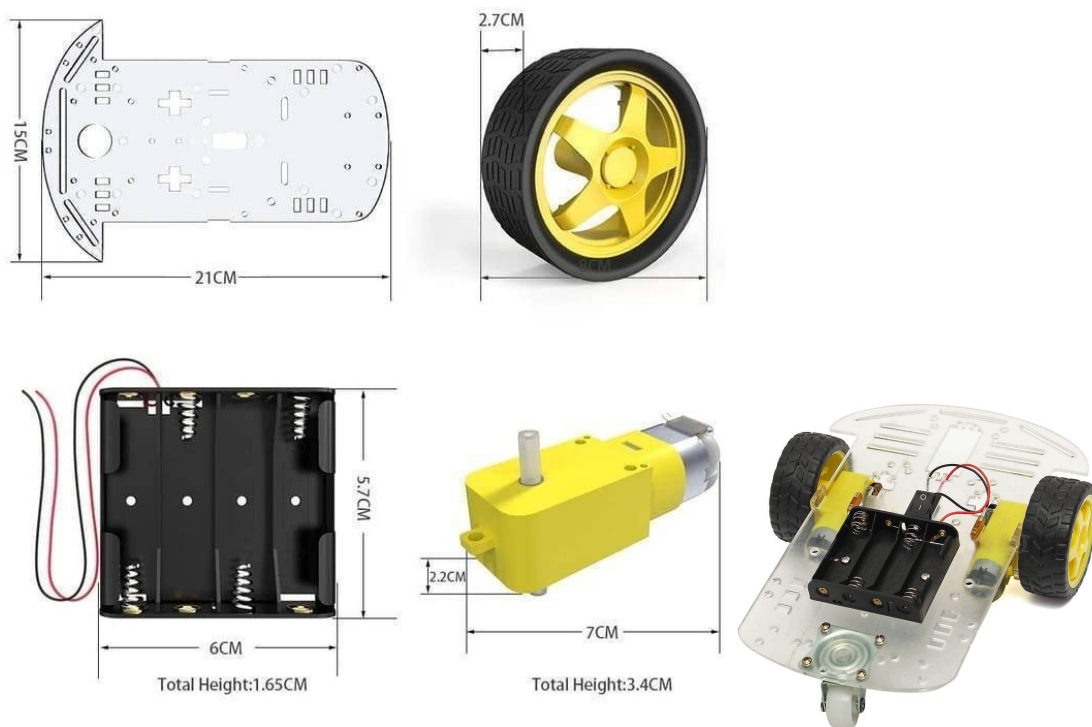


Figure 1: Dimensions of the Robot

## 2.5 Mobility Requirements

Following three requirements must be met for the motion of the robot:

- 1 Linear Motion: Robot should be able to move in a linear fashion without wobbling and deviating from single linear path.
- 2 Rotational Motion: Robot should be able to rotate smoothly at angle desired to detect and move towards the opponent robot.
- 3 Safety Net: Robot must include safety feature in terms of rubber lining or slinky ring to minimize damage upon collision. Students can also devise their own safety mechanism in case of hard collision.

## 2.6 Communication Requirements

Robot can use either of the two options, mentioned below, to establish remote communication with their cellphones/laptops etc:

1. Bluetooth module with Serial Terminal to send and/or receive commands and/or sensors data, information, either automatically or upon request.
2. RF module with same specification as above.
3. Any other Wifi/GSM/Wireless communication module can also be used by students.

## 2.7 Sensors and Hardware Usage

The Robot must incorporate the following sensing elements or related hardware:

- Processing hardware must include TivaC Launchpad, could optionally also include Arduino or any other microcontroller with proper justification for its usage.
- Structural hardware must include base and/or wheels and other supporting material for attack/defense.
- Mobility hardware must include motors, motor drivers and/or servos.
- Detection/distance measurement hardware should include either one or more ultrasonic sensor and/or IR proximity sensors.
- Communication hardware may include Bluetooth Module or RF Module or any other justified communication protocol.
- Additional functionality hardware like keypad, LCD, 7-Segment, data acquisition (temperature, pressure, humidity etc) sensors can earn the group bonus marks.

## 3 Arena Specification

The two robots will be placed in the arena for fight as shown in Fig. 2.

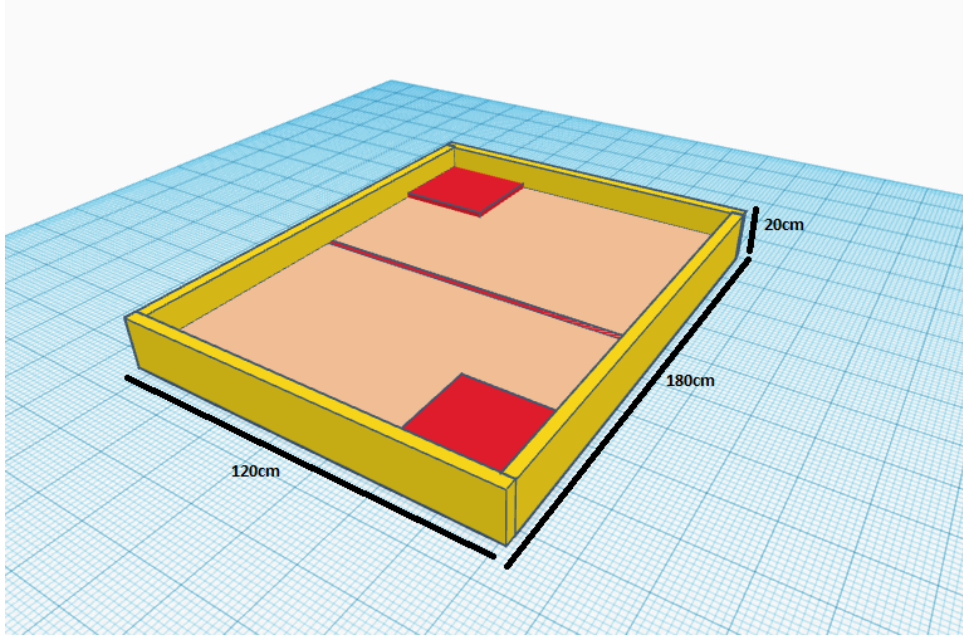


Figure 2: Arena Specification

## 4 Components Availability

#	Items	Availability
1	TivaC LaunchPad	Issued with Kit
2	Micro USB cable	Issued with Kit
4	Jumper Cables	Issued with Kit
5	Breadboards	Issued with Kit
6	Seven Segment Displays	Issued with Kit
7	Push Buttons	Issued with Kit
8	LEDs	Issued with Kit
9	Ultrasonic Sensor	Issued with Kit
10	DC Motor	Issued with Kit
11	Motor Driver Module	Issued with Kit
12	LDR	Issued with Kit
13	LCD	Issued with Kit
14	Keypad	Issued with Kit
15	Robot Chassis	One per Group
16	2x Wheels with Motors	One per Group

## 5 Milestones Schedule

Milestones	Deliverable	Week	Grade
Project Kick-off	Read the specification document carefully	Week 02	—
Milestone-0: Team Formation	<ul style="list-style-type: none"> <li>Timely submission of names of group members and group tag</li> <li>Submit the name of one volunteer from each team to work on the arena</li> </ul>	Week 03	5%
Milestone-1: Design Approach Report	<ul style="list-style-type: none"> <li>Submit a one-page report, discussing the approach to design the structure, briefing about the sensing and actuating sub-units of the robot</li> <li>The report should include a CAD or neat and detailed hand-drawn version of your mechanical structure and placement of the components</li> <li>Report must also include the task division among the team members</li> </ul>	Week 06	10%
Milestone-2: Mechanical and Electronic Structure	<ul style="list-style-type: none"> <li>Bring the mechanical structure to Lab. It should include attacking mechanism and a base with motors, and tires. It should have an outer cover, with safety lining</li> <li>Assemble mechanical structure and electronic circuitry</li> <li>Arena must be ready for test run</li> <li>Submit one-page report, discussing the structure design (theory, mathematics)</li> <li>Get the checklist signed by the RA</li> </ul>	Week 09	20%
Milestone-3: Modules and Sensor Interfacing	<ul style="list-style-type: none"> <li>Interfacing with sensors such as ultrasonic/IR/RF or other used</li> <li>Mobility and communication modules should be functional</li> <li>Get the checklist signed by the RA</li> </ul>	Week 12	20%
Milestone-4: Computational Demo	<ul style="list-style-type: none"> <li>Computational, mobility and communication subsystems should be operational such that robot can navigate, move and communicate</li> <li>Get the checklist signed by the RA</li> </ul>	Week 13	20%

Milestone-5: Individual Demo	<ul style="list-style-type: none"> <li>• Live demo of the robot inside arena with all components functional along with operational attack and defense mechanism</li> </ul>	Week 14	20%
Competition	Competition Day: Each robot will be assigned opponent robot and winner team will work their way up the competition chart to the final	Week 15	5%

## 6 Contest Rules

Will be shared later on with detailed score rubric document.

## 7 Resources for Requirements

Following are some of the links to help you give an idea about structure of battle bot, however, it should be noted that these battle bots are built with difference microcontrollers and you are necessarily required to use TivaC LaunchPad:

- <https://www.instructables.com/Cheap-Arduino-Combat-Robot-Control/>
- <https://create.arduino.cc/projecthub/Barqunics/how-to-build-a-battlebot-with-arduino-and-cardboard-5633a4>
- <https://create.arduino.cc/projecthub/codedigs/build-a-battle-bot-controlled-with-a-ps2-controller-fbc033>
- <https://create.arduino.cc/projecthub/projects/tags/robot>