



The IEEE Region 10 Robotics Competition

Terms of Reference

2022

Executive Summary

This high-level document describes the reasons for establishing the R10 Robotics Competitions and envisaged benefits for the IEEE members in the region.

The R10 Robotics Competition aims towards IEEE student members and young professional members who graduated within the last five years. The main objective of the competition is to create awareness amongst young IEEE members about the importance of technology in providing solutions to real-world problems by harnessing their creativity and capabilities. In addition to stimulating technical ingenuity, the competition also aims to help participants polish their professional and personal skills.

The competition will be held in the following three stages:

Stage 1: Section Level – Organized by local IEEE Sections to pick the best team(s) to go forward in the online R10 competition in Stage 2. For Stage 1, IEEE Sections will be encouraged to organize robotics activities such as workshops and technical talks, and arrange robotics competitions and hands-on workshops for school children to inspire younger people to STEM. Sections will also be urged to invite local industry leaders and Government officials to these events.

Stage 2: R10 Level online rounds for 2 to 3 days. The winners of this stage will progress to Stage 3, which is planned to be a physical gathering.

Stage 3: Real R10 Level – A mega-event with a Technology Exhibition and the Awards Ceremony at a gala dinner. If the physical gathering is not possible for any reason, then the final stage will be held online.

R10 will provide funding to Sections to organize the local activities in Stage 1. In Stage 2 teams found potentially strong for innovative robot ideas may also be funded to enhance the robots. All funding under the R10 Robotics Competition will strictly adhere to the R10 Matching Fund Policy.

In the first two to three years, the primary financial support for the IEEE R10 Robotics Competition is expected from the IEEE Region 10. However, for the longer-term sustainability of the competition, it is imperative to find sponsorships and turn this competition into a self-sustainable prestigious R10 flagship program.

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1. IEEE Region 10 Robotics Competition

1.1 Introduction

One of the most effective approaches to inspire young and old professionals alike is to offer them motivational opportunities to learn through experience, apply their skills and experiences to something they can proudly take ownership of, and kindle interest in others to follow them. Robotics is a multi-disciplinary field (hardware, coding, digital signal processing/image processing, artificial intelligence, etc.) that offers a hands-on opportunity to apply classroom theory to building a substantial piece of engineering that can serve a useful purpose. Thus, such pursuits allow a deep understanding of the problems and challenges of building robots for a practical solution.

Building robots is not only stimulating for engineers but also captivating for users and onlookers. Robotics demonstrations are inspirational for young minds to undertake STEM subjects. Owing to their exhilarating appeal, robotic competitions attract significant interest from many people, both technical and non-technical, and therefore gain significant exposure through news and social media channels. The proposed IEEE Region 10 Robotics Competition will serve as a great vehicle to ignite passions among young IEEE members, retain current members, attract new members and promote STEM education among the younger generation. It will also provide means to serve the purpose of problem-solving and raise IEEE visibility among the communities, local government departments, and industry. Furthermore, an attractive prizes scheme is aimed to give an impetus towards innovation and launch of Start-up companies.

The proposed robotics competition will be open to only IEEE members and will be held in three stages, starting from initial rounds at the local IEEE Sections' level and progressing towards two stages at the regional level. The competition assessment criteria at all three stages will focus more on the demonstrated learning and personal development, usefulness, efficiency and affordability of the robots.

R10 Robotics Competition will encourage other interested regions to conduct similar competitions so that the winners of Stage 3 can take part in a worldwide IEEE Robotics competition and compete for even bigger prizes.

1.2 Competition Main Objectives

The competition aims to create awareness amongst undergraduate students about the importance of technology in providing solutions to real-world problems by harnessing their creativity and capabilities. Therefore, the primary purposes of the competition include (a) realization of the development of robotics-based solutions and (b) encouraging entrepreneurship among younger IEEE members. More specifically, the competition aims to:

- Create opportunities for learning by applying classroom lessons and enabling methodologies to design a robot,
- Stimulate thought process for innovative ideas, and
- Develop students' abilities to:
 - Study and understand the problem,
 - Analyze and decompose requirements,

- Conduct literature review and essential background research,
- Avoid violation of copyright and intellectual property rights of other researchers,
- Learn to use software tools to build robot models.

In addition to stimulating technical ingenuity, the competition also aims to help participants to:

- Build teamwork spirits – Learn to optimize team members’ abilities to achieve project goals.
- Develop leadership skills – (a) Ability to set goals and effectively communicate plans and strategies to the team members, (b) ability to listen to alternate views and make timely decisions.
- Develop project management skills – Participants are required to apply project management principles to (a) identify project goals, (b) prepare a work breakdown structure (WBS) with realistic timelines, (c) determine key milestones leading to the completion of the project, (d) manage time and resources.
- Sound Engineering Practice – Documentation and recording keeping for (a) robot design features requirements, (b) design decisions, i.e., different options contemplated and the reasons for selected options, (c) ability to trace back the technical errors if any and troubleshooting, (d) foundation for future developments, and (d) proof of originality and ownership of the work.

Some added benefits of the competition are (1) highlighting the benefits of IEEE membership for members and non-members and (b) promoting STEM education among the younger generation. Furthermore, the proposed robotics competition is envisaged to create an opportunity for the first time for IEEE members in the Region to compete against teams from other Sections and countries. It will also facilitate networking to develop technical solutions for the benefit of humanity.

1.3 Main Contestants

In 2022, the inaugural year of the competition, the contestants will be limited to IEEE Student members, Graduate Student member and Young Professionals members.

The main groups of IEEE members, therefore, envisaged to participate in 2022 are:

1. Students (undergraduate (UG) & post-graduates (PG)) and
2. Young Professionals (YP) graduated not more than 5 years ago.

In the future, a third group of senior professionals from the industry can be added to the competition based on the experience and lessons learnt in the first year.

1.4 Competition Organisation

The competition will be organized in the following three stages:

Stage 1: Section Level – Organized by local IEEE Sections to pick the best team(s) to go forward in the online R10 competition. For Stage 1, IEEE Sections will be encouraged to organize robotics activities such as workshops and technical talks and arrange robotics competitions and hands-on workshops for school children to inspire younger people to STEM. Sections will also

be urged to invite local industry leaders and Government officials to these events.

Stage 2: Virtual Mode – R10 Level online rounds for 2 to 3 days. The selected teams from this stage will progress to Stage 3, which is planned to be a physical gathering.

Stage 3: Real R10 Level – A mega-event with a Technology Exhibition and the Awards Ceremony at a gala dinner. If the physical gathering is not possible for any reason, then the final stage will be held online.

The main features of all three stages of competition are briefly given below.

1.4.1 Competition Stage 1

- (1) Competitions at Section level (all Student Branches (SB) and Young Professional (YP) & Women-in-Engineering (WIE) Affinity Groups) – Physical participation at a venue organized by the Section (subject to local regulations and COVID Standard Operating Procedures (SOPs)).
 - (a) Stage 1 will be for R10 specified categories under the rules defined by the R10 Robotics Competition Organising Committee. R10 Committee will also specify the assessment criteria.
 - (b) Successful demonstration to local judges.
 - (c) R10 funding for Sections to host local level competition (appropriate amount to be determined) subject to Section's contribution in cash and kind.
 - (d) Invitations to local industry leaders and Government officials (for local support and sponsorship).
 - (e) Invitations local educational institutes, including primary and secondary school children, to come and participate in simple competitions and robotics workshops for inspiring young students to STEM (Small prizes and certificates).

1.4.2 Competition Stage 2

Stage 2 rounds will be organized by R10 in a virtual mode over 2 – 3 days, with up to four hours each day to make provision for significant time differences across the region.

The qualified teams will be required to submit:

- (1) A submission form with team details and endorsement by the Section Chair.
- (2) A 6-minute video (mp4 format) for demonstration of robot design and functionality
- (3) A Project Technical Report explaining (aims to polish participants technical report writing skills and allow judges to have a better understanding of the robot)
 - Executive Summary
 - Team members and their contributions (Team strength)
 - Refinement of project ideas (Thought process)
 - Background research about existing solutions (Literature review)
 - Design considerations (Tradeoffs & key features)

- Technical challenges resolved (Tackling technical difficulties)
 - Key hardware options and Coding solutions (Technical details and optimization)
 - Innovation and its social impact (What is new and how useful is the solution, including any adverse effects).
- (4) Besides demonstrating the robot's functionality, each team would be allowed to present any additional information about their project, including the introduction of the team, the research, the development of the robot, and the cost. There would not be a pre-described format for presenting the additional information, but there will be a time limit of 2 minutes.
 - (5) The judging panel may ask questions to clarify or understand the robot design and functionality.
 - (6) The top teams in each category from each group (student and YP) will advance to Stage 3.
 - (7) Teams with robots demonstrating high potentials for marketability and/or functional capabilities would be selected for R10 funding for robot enhancements.
 - (8) Those not qualified for Stage 3 but demonstrated innovative/interesting ideas in Stage 2 will get a consolation prize.

1.4.3 Competition Stage 3

Stage 3 will be the final round of the competition. Subject to the COVID-19 situation in 2022, Stage 3 will be arranged as a physical gathering for winners of Stage 2 teams to compete against each other. The plans for Stage 3 include:

1. A two-day competition at the regional level with invited keynote speakers from industry and robotics research academics.
2. Open to all IEEE members in the vicinity of the event to attend.
3. International Judging Panel supported by local judges and referees/adjudicators.
4. Sponsorship from industry – A sponsorship package will be prepared to inform potential sponsors about the benefits of their support, for example, short slots for the technical presentation of commercial products related to engineering, display of logos on promotion/publicity material and acknowledgement at prize distribution ceremony.
5. Closing ceremony with chief guest, prize distributions and cultural show.
6. Noteworthy prize money.
7. Exposure of talent in R10 through social media and IEEE news channels (R10 YouTube channel and IEEE TV).
8. IEEE Sections will be required to provide partial financial support to their teams to participate in Stage 3.

1.5 Competition Categories

Each year a theme will be decided for the robotics contests in the following three categories:

- (1) Modeling and Simulations for Robot Development (for undergraduate students),
- (2) Robot Development in hardware (for undergraduate students),
- (3) Robot Development in hardware (for postgraduate students and young professionals who have graduated not more than 5 years ago).

Region 10 is very diverse in many ways. In some of the countries, they have bright students but not well-equipped labs or enough funds to build hardware. Students from those countries can participate by using a free software package like ROS and Gazebo for modeling and simulations. Undergraduate students will have a choice to either build a digital model or build a robot in hardware plus coding. Since modeling & simulations (M&S) is an essential phase for validating concepts and testing out the algorithms before making the real robot, the Postgraduates & YP contest will have an initial phase of CAD modeling to refine the robot design.

1.6 Eligibility Criteria

IEEE Student members, Graduate Student members, and Young Professionals (YP) members are eligible to participate in the competition. IEEE Student members enrolled for a Bachelor's degree in electrical engineering, electronics engineering, computer science, or any other field of interest of an IEEE Society are classified as eligible undergraduate students (UG).

Young Professionals must not have graduated more than 5 years ago.

- Participants in the contest can be individual or a team as explained below:
 - Individual (must be an active IEEE student or YP member)
 - Team-based. The number of team members is limited to:
 - (1) For the modelling and simulation project a maximum of 4 members and
 - (2) For building a robot hardware and coding project (undergraduate, postgraduate & young professionals categories) a maximum of 6 members.
 - Modelling & Simulation Project: Majority of team members must be IEEE student members. For example, in a 3 or 4-member team a maximum of one non IEEE member can be in the team. The team can NOT have an equal number of IEEE members and non-members.
 - Robot Hardware Project (UG, PG & YP): Majority of team members must be IEEE members. For example, in a 6-member team a maximum of two non IEEE members can be in the team. The team can NOT have an equal number of IEEE members and non-members.
 - To qualify as a WIE team, the majority of team members must be female IEEE members and not just the majority of female members. The team can NOT have an equal or more number of males than female members.
 - Non-IEEE members in the team will not be eligible for a cash prize. However, they can receive a certificate of participation.

1.7 Rules

- Submission must be for one of the categories of the robotics competition.

- A team can work on only one project. Submissions from the same team for more than one project will not be accepted.
- The competition will be conducted in English, i.e., all submissions, including project documentation must be in English. However teams will be allowed to arrange the services of a translator to answer judges' questions at all three stages of the competition.
- Stage 1 will be arranged locally by the IEEE Sections with an overall guideline from R10. Each IEEE Section will be allowed to select two teams for each competition project to compete in Stage 2.
 - A Section can put forward upto two teams for anyone of the competition projects.
 - A maximum of six teams corresponding to the three competition projects will be accepted from a Section for Stage 2.
- Robot projects must be original and must not contain plagiarized material, and must not violate any copyright or intellectual property rights.
- The contestants cannot use hardware developed for another project or use a commercially available robot for the competition. Similarly contestants cannot use predeveloped CAD models available on the Internet.
- The 6-minute video must be associated with a correctly completed submission form. Any submission that is more than 6 minutes long will be disqualified.
- Rough sketches and notes will NOT be accepted as proper engineering notes/reports. Instead, participants must properly document robot design features, modeled or used components with interconnections, and written codes.
- The judges' decision will be final in all three stages, and no appeal against the judges' decision will be entertained.
- IEEE Region 10 and R10 Robotics Competition Organising Committee will not be responsible for the copyright or Intellectual Property violations by the participants. Therefore, it is the sole responsibility of the participants to ensure that no copyright and Intellectual Property rights are violated in the material submitted for the competition.
- IEEE Region 10 reserves the right to amend competition rules to remove any ambiguity. Any changes in the competition rules will be announced on the R10 website, and it will be the responsibility of the participating teams to check the changes and abide by the rules.
- R10 Director can at any time cancel the competition if the participation rate is very low or for any other reason deemed by the R10 Director as valid for the cancellation.
- In addition to the above rules, each competition project will have its own specific rules that must be followed.

1.8 Assessment Process

Generally, the assessment criteria will focus on the usefulness, efficiency, and affordability of the robots. The assessments will also give weight to develop members' soft skills like project planning and management, technical report writing, and presentation of complex subjects to both technical and nontechnical audiences.

For each category, a panel of judges will be appointed to carry out the judging and mark according to a scoring rubric especially developed for the contest category.

For Stage 1, the local Section will organize the judging panel consisting of local experts and senior IEEE members. For Stage 2 and Stage 3, R10 will organize panels of international experts to examine the entries against the specified assessment criteria.

1.9 Prize Scheme

The R10 Robotics Competition will offer an attractive prize scheme to encourage innovation and entrepreneurship, promote STEM and enhance IEEE visibility in the communities. Generally, the prize scheme will consist of:

Stage 1 Prizes: These will consist of certificates and maybe cash prizes depending on the sponsorship from the local industry and relevant government departments. Sections would also be encouraged to invite local school children to participate in the competition and offer them some prizes for encouragement and inspiring them to study STEM subjects.

Stage 2 Prizes: In Stage 2, the top teams will win the financial support to enhance their robots and improve their chances to be successful in the final stage (Stage 3) of the competition. Those not able to qualify for Stage 3 but demonstrate innovative/interesting ideas in Stage 2 will get a consolation prize.

Stage 3 Prizes: The prize scheme for Stage 3 will consist of

1. One Grand Prize of the competition
2. Team Prizes for each competition project
 - a. A cash prize for the first position and a certificate,
 - b. The second position cash prize equivalent to 70% of the first cash prize plus certificate, and
 - c. The third position cash prize equivalent to 50% of the first cash prize plus certificate,
3. There will be one special prize for IEEE Women-in-Engineering members for the encouragement of young women studying engineering-related courses or working in engineering professions. This is expected to inspire young females to study STEM courses.

It will be up to team members to decide how to split the cash prize among team members who are IEEE members. Cash prizes are not for non-IEEE members but they can receive participation certificates.

R10 Director can approve a different cash prize arrangement instead of above mentioned scheme.

2 Competition Administration

The R10 Robotics Competition will be a joint endeavor of several R10 committees including R10 Students Activities Committee (SAC), R10 YP Committee, R10 WIE Committee, R10 Humanitarian Technology Activities (HTA) Committee and R10 Industry Relations Committee (IRC). The Chairs of these core committees will be responsible to (1) make policy decisions and (2) assist in successful conduct of the

competition. All policy decisions will be reviewed by an Advisory Committee and approved by the R10 Director.

R10 Director will approve a R10 Robotics Competition Organizing Committee and will appoint the Chair of the committee. The Organizing Committee Chair shall be responsible to recruit appropriate volunteers to undertake required tasks for the competition.

2.1 R10 Funding Policy

All funding under the R10 Robotics Competition will strictly adhere to the R10 Matching Fund Policy as explained below.

- For Large Section, R10 can support up to 50% of total expenses but no more than the maximum limit set for funding.
- For the Medium Section, R10 can support up to 75% of total expenses but no more than the maximum limit set for funding.
- For the Small Section, R10 will support 100% of total expenses but no more than the maximum limit set for funding.

For example, R10 funding with a maximum amount of US\$ 400 would mean that if an activity expenses are US\$ 600, then in case of a large Section the R10 contribution would be US\$ 300 (50%) and for a Medium Section it will be US\$ 400 (maximum limit) and not US\$ 450 (75%). Similarly, in the case of a small Section R10 will fund no more than US\$400 (maximum limit) even if the expenses are US\$ 401. The residual funds will have to be supported by the Section and/or from any other source of funding.

IEEE Sections are classified as Large, Medium or Small as follows:

- Large Section: 1,501 or more members (including Students) as of 31 December of the prior year.
- Medium Section: 501-1,500 members (including Students) as of 31 December of the prior year.
- Small Section: 500 or fewer members (including Students) as of 31 December of the prior year.

2.2 Dissemination of Information

The R10 Robotics Organizing Committee will create a webpage on the R10 website where all relevant documents shall be available for the participants. The webpage will also have links to submit enquiries and upload submissions for the competition.

The R10 Robotics Organizing Committee will also setup a Discussion Forum for the participants to exchange ideas and discuss technical issues. The Discussion Forum will be moderated by a moderator appointed by the Chair of the R10 Robotics Competition Organizing Committee.

2.3 Disclaimers for Competition Projects

All documents describing the competition projects will display following disclaimers on the front page:

1. IEEE Region 10 and R10 Robotics Competition Organising Committee will not be responsible for the copyright or Intellectual Property violations by the participants. It is the sole responsibility of the participants to ensure that no

copyright and Intellectual Property rights are violated in the material submitted for the competition.

2. IEEE Region 10 reserves the right to amend competition rules to remove any ambiguity. Any changes in the competition rules will be announced on the R10 website and it will be the responsibility of the participating teams to check the changes and abide by the rules.
3. R10 Director can at any time cancel the competition if the participation rate is very low or for any other reason deemed by the R10 Director as valid for the cancellation.
4. The material and information contained in this document is for general information only. You shall not rely upon the material or information as a basis for making any business, legal or any other decision. Neither IEEE Region 10 nor any of its members, directors, employees or other representatives will be liable for damages arising out of or in connection with the use of these information contained herein. IEEE Region 10 reserves the right to add to, change, or delete its content or any part thereof without notice."

3. Sustainability of the Competition

The R10 Robotics Competition is a substantial commitment of both humans as well as financial resources. IEEE human resources in the shape of volunteers are very strong, which is especially true in the case of R10. R10 volunteers are very dedicated and skilled to take on the challenge of organizing a mega-event like the R10 Robotics Competition.

On the financial side, it is imperative to find sponsorships to sustain the competition and turn it into a prestigious R10 flagship program. The money raised through sponsorship can support the high cost of travel, accommodation, prize money, and other expenses. Other IEEE entities like IEEE Foundation, New Initiative Committee (NIC), all relevant IEEE Technical Societies, and MGA SIGHT should also be approached to support the competition financially, especially if the competition is aligned with their objectives. R10 will commit a significant amount of money for the competition. It is also expected that Sections will also be required to commit some financial support for the local level activities related to the competition.

R10 Robotics Competition will set an example for other interested IEEE Regions to conduct similar competitions so that the winners of Stage 3 can take part in a truly worldwide IEEE Robotics competition.

Stage 2 and Stage 3 of the competition can be organized in conjunction with one of the R10 events. For example, collaboration with one of Region 10 flagship conferences can maximize the audience for the competition. However, this will require proper practicability assessment, both logistically and financially.

If the situation with the COVID-19 restriction does not improve, then Stage 3 can be held online like Stage 2. R10 will monitor all potential calamities, like the COVID-19 situation, and a "GO/NO Go" decision for Stage 3 physical gathering should be made around late July to early August.