NATIONAL ROBOTICS COMPETITION

NRC Open Category 2024

PRIMARY, SECONDARY, TERTIARY

CHALLENGE BOOKLET

Version: 28 March 2024

Organised by:

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NRC 2024 OPEN CATEGORY

CHALLENGE BOOKLET CHANGE LOG

Version	Release Date	Description
1.0	28 March 2024	Official Challenge Booklet release

Contents

1. General Information

1.1. National Robotics Competition (NRC) 2024

National Robotics Competition (NRC) has been an ongoing competition organised annually by Science Centre Singapore for the past 25 years with support from the Ministry of Education, various partners and sponsors. The competition has attracted more than 65,000 participants and 260,000 supporters to date.

NRC spurs students' interest and innovation in Science, Technology, Engineering and Mathematics (STEM). Students will be able to put their knowledge to practice and engage in hands-on STEM learning. With NRC as a stage for students to develop kinaesthetic learning and collaboration, it encourages students to develop problem solving skills, entrepreneurial skills, creative thinking skills and team spirit among the participants.

NRC promises to be filled with exciting challenges that will ensure a fun and meaningful learning experience for the participants. NRC is also an excellent opportunity for students to interact with their peers, teachers and judges from the various industries during the course of the competition.

NRC 2024 tournaments comprise:

- NRC Regular Category
- **NRC Open Category**
- NRC AI Maker Series
- NRC Preschool
  - Kubo Challenge
  - ARTec Challenge
- NRC Smorphi
- NRC RoboCup Singapore CoSpace Coding Challenges
  - Autonomous Driving Category
  - Rescue Category

Registration for these category challenges will be via https://www.gevme.com/NRC2024.
Competition registration opens from **1 March to 1 July 2024.**

Note: Registration will be on a first come, first serve basis. If the category is full, your registration will be rejected and refunded.

1.2. Theme for NRC 2024

The annual NRC revolves around a specific theme and this year, the theme for NRC is "**Water (H_2O) Heroes**". Safe drinking water refers to water that is free from harmful contaminants and suitable for human consumption without health risks. Clean water is vital for public health and preventing waterborne diseases. Access to safe drinking water is a fundamental human right, essential for sustaining life and promoting overall well-being. As H_2O Heroes, how can we ensure the availability and sustainable management of water and sanitation for all?

2. Teams and Rules Hierarchy

2.1. Team Definition

Each team will have a minimum of 2 members and up to 3 members.

This category is open to the following age groups:

- Primary: students 7-12 years old (in season 2024: born years 2012-2017)
- Secondary: students 13-16 years old (in season 2024: born years 2008-2011)
- Tertiary: students 17-19 years old (in season 2024: born years 2005-2007)

Students need not be from the same school. However, all the members of a team must be in the same category age group to qualify.

2.2. Expectations on Teams

Teams should behave fairly and be respectful towards other teams, coaches, judges and competition organizers. Teams are to adhere to the competition rules to ensure fair competition.

The construction and coding of the robot may be done only by the team. The task of the coach is to accompany them, help them with organizational and logistical matters and support the team in the case of questions or problems. The coach cannot be involved in the construction and programming of the robot.

On the competition day, during presentation judging, coaches/mentors are not allowed to communicate with or guide their teams or interfere with the judging process.

If any of the rules mentioned in this document are broken or violated, the judges or chief referees can decide on one or more of the following consequences. Before a decision is reached, a team or individual team members may be interviewed to find out more about the possible violation of the rules. The interview can include questions about the robot or the program.

- A team may get up to a 50% reduced score for one or more judging rounds.
- A team may be disqualified completely from the competition immediately.

2.3. Rules Hierarchy

On the competition day, the following rule hierarchy applies:

- General Rules for NRC Open Category provides the basis for rules in this category.
- Questions & Answers (Q&As) can override rules in the general rule document.
- **The Chief Referees have the final say in any decision.**

During a season, NRC may publish additional Question & Answers (Q&As) that can clarify, extend, or re-define rules in game and general rule documents. Teams should read these Q&As before the competition.

3. NRC Open Category

3.1. Introduction

The UN Sustainable Development Goal 6 focuses on Clean Water and Sanitation. Target 6.1 aims to achieve universal and equitable access to safe and affordable drinking water for all by 2030. However, to meet the goal of ensuring sufficient drinking water by 2030, we need to work four times faster than our current pace.

Teams are tasked with developing a robotic solution that addresses one or more key challenges in ensuring sustainable access to safe drinking water, as outlined below.

a) Water purification

Although about 70% of earth's surface is covered with water, only a limited amount is clean and suitable for drinking. To make water suitable for drinking, an important first step is to purify the water by removing contaminants and impurities from the water. Some potential uses of robots include water quality monitoring at reservoir, treatment plant automation and cleaning etc.

Teams are to develop robotic solutions to enhance the efficiency, accuracy, or reliability of water purification systems or processes.

b) Water distribution

The potable water produced from the treatment plant has to be distributed to reach the residential, commercial or industrial sites. The distribution system comprises pipelines, storage facilities, pumps, and other accessories. A critical challenge in water distribution is to reduce the amount of water loss. Some potential roles of robots in water distribution include leak detection, pipe inspection and maintenance, repair, autonomous transportation of water during emergency etc.

Teams are to develop robotic solutions to increase the reliability and resilience of the water distribution system.

c) Water conservation

Water is a precious commodity. This is especially critical for Singapore due to our limited natural sources of fresh water. Water conservation efforts include optimizing water use through reuse and recycling, reducing waste, and adopting water-efficient processes across various sectors. Some of the roles robots can play in water conservation includes leak detection, aquatic habitat restoration, water recycling, etc.

Teams are to develop robotic solutions to address water conservation challenges.

Teams are to choose **one or more** of above topics to work on for their robotic solution.

3.3. Project Booth

Teams are required to present their robotic solution in a project booth or a designated area. The booth size approximately 1m x 2.4m Ht, including a system cabinet. Each team will have one vertical display surface for the booth, and they can showcase their robot on the system cabinet.

Teams should utilize the booth to present information about their research and the development of the robotic solution. All booth decorations and setup, including the robotic solution, must remain within the booth area. Teams that exceed the boundary with props, decorations, or robots will face penalties.

If liquids are necessary for the project, teams are restricted to use water only.

4. Presentation & Judging

Teams in this category are required to follow the process outlined below on the competition day:

- Set up their project booth and conduct testing of the robotic solution
- Present the robotic solution in one or multiple judging sessions

During each judging session, which lasts for 15 minutes, groups of 2-3 judges will visit teams at their booth. Each team will have 10 minutes to present the project idea and demonstrate the robotic solution live at the project booth. Subsequently, judges will engage in a 5-minute Q&A session with the team. There will be multiple judging session.

Teams are responsible for familiarizing themselves with the competition day schedule and ensuring their presence at the booth for the judging session. The team must ensure that the booth is prepared, and the prototype is on stand-by before the judges arrive.

If a robotic solution does not function during a judging session, the team should try to troubleshoot before the next judging session.

Do note that there is a minimum number of teams for the judging to proceed for each level. If the registration number falls below 10 for any level, it will be combined with the next closest level for judging.

4.1. Expectations For Each Age Group

Primary (7 – 12 years old)

If you are in this age group, you will need to explain how your robotic solution will address the problem statement(s) in your school environment and improve the situation.

Secondary (13 – 16 years old)

If you are in this age group, you will need to explain how your robotic solution will

address the problem statement(s) in society and your community.

Tertiary (16 – 19 years old)

If you are in this age group, you will need to explain how your robotic solution relates to the problem statement(s) and how it can become a reality. Describe the possible challenges and demonstrate which problems must be solved to prepare your robot model for global use.

5. Awards and Prizes

For each category – Primary, Secondary and Tertiary respectively:

Category	Rank	Prize
Open Category*	1st	Cash prize of $500, Trophy [1 per team], Medal & Certificate for each team member
	2nd	Medal & Certificate for each team member
	3rd	

Across all categories:

Awards	Remarks	Prize
Best Booth Design Award*	For the team(s) that designs and puts up the most creative and outstanding booth	Medal and Certificate for each team member
Judges Awards*	Apart from all the awards listed, judges may present Judges Awards to teams and/or individuals that have displayed outstanding attributes (during the competition) that set them apart in a unique way.	

The Organiser reserves the right to not award the full list of awards and prizes above without prior notice.

*The specific number of awards listed that will be presented to teams will be subjected to the judges and chief referees' decision, independent of the overall scoring of the teams.

Kindly note that:

a) The minimum number of teams for each age group is 10 for judging to proceed, otherwise the age group will be combined with the next closest age group for judging.
   E.g. A total of 20 Secondary Teams and 3 Tertiary Teams have registered, the Tertiary level teams will be judged together with the Secondary level teams.
b) Organisers reserve the right to limit the total number of teams each school/robotic centre is allowed to send for the open category.

6. Glossary

Coach	A person assisting a team in the process to learn different robotics aspects, teamwork, problem solving, time management, etc. The role of the coach is not to win the competition for the team, but to teach them and guide them through the problem identification and work with them to discover ways to solve the competition challenge.
Judging Session	Teams are judged during the judging sessions. There will be multiple judging session and each session is 15 minutes, with 10 minutes allocated for the team's presentation and 5 minutes for Q&A by the judges.
Project Booth	The project booth is the place where teams present their solution. The project booth's dimensions are 1m x 2.4m Ht.
Robotic Solution	The robotic solution is the core result of the team's work and cannot be larger than the project booth. The solution can use one or multiple robot devices. Every robot should work autonomously and not be operated by a remote control. Any remote controlled or additional devices are only allowed if this is connected to the solution for the real world (e.g. interacting with humans). There is no restriction on the use of controllers, motors, sensors, or any other building equipment the team needs to create their robotic solution and project booth. Teams can use any software / programming language to code the robotic solution.
NRC	In this document, NRC stands for National Robotics Competition.

7. Scoring rubric

Category	Criteria	Points
1. Project (Total Points: 30)	**1. Creativity** – The project is original, innovative and demonstrates creative thinking.	10
	2. Quality of Solution – The project is well-thought out is an effective solution to the chosen problem statement. Prototype development and steps of the project is elaborated clearly.	10
	3. Limitations – The team is able to identify limitations in their design and improvise their solutions to overcome these limitations.	10
2.Programming (Total Points: 30)	**1. Automation** – The project uses appropriate inputs from sensors to run specific routines and clearly demonstrates automation in the completing of the tasks.	10
	2. Good Logic – The programming options used are relevant, work reliably and efficiently.	10
	3. Readable and understandable – Codes are easy to follow e.g variables are well named, good use of comments	10
3. Engineering Design (Total Points: 50)	**1. Technical Understanding** – Team members is able to produce clear, precise, and convincing explanations about each step of the mechanical and programming process.	10
	2. Engineering Concepts – The project shows evidence and good use of engineering concepts. The team is able to explain the concepts and part usage.	10
	3. Mechanical Efficiency and structural stability – Parts and energy have been used efficiently - evidence of proper use of mechanical concepts / principles (gears/pulleys/levers/wheels & axles). The project (robots and structures) are strong, sturdy and the demonstration can be run repeatedly - parts don't detach - little need for repairs.	10
	4. Overall Design and Aesthetics – The mechanical elements have aesthetic appeal, there is evidence that the team went out of their way to make the project look as professional as possible. The robot design is unique and creative.	10
	5. Successful Robot Demonstration – A successful demo of the robotics solution prototype has been completed, with an indication that it could be demonstrated repeatedly.	10
4. Presentation (Total Points 30)	**1. Communication –** The team is able to present their project in a clear, concise and engaging way. Presenters made eye contact with the audiences and presented fluently and smoothly without reading from script or slides.	10
	2. Quick Thinking & Reasoning Skills - The team is able to easily answer questions raised by the judges about their project. They are also able to deal with any problems that arose during the presentation	10
	3. Entertainment Value – The team is able to present their project idea in an interesting way. The project has a certain "WOW" factor - looks fun, captures the attention of passer by - makes you want to see it again or learn more about it.	10
5. Learning Journey (Total Points: 20)	**1. Learning Outcome** – There is evidence that team members have internalized knowledge and understanding of the subject matter pertaining to their project. Team shares about their learning journey and how they address challenges.	10
	2. Teamwork – The team is able to demonstrate that all members played an important role in the development, construction and presentation of their project. The team display positive energy, good cohesiveness, value one another and are enthusiastic and excited about sharing their project with others.	10
	Maximum Points	**160**