NATIONAL INSTRUMENTS AUTONOMOUS ROBOTICS COMPETITION (NI ARC)

LEARNING OUTCOMES

- Apply kinematic models to design and control a mechanical wheeled robot
- Apply control system theory to design and implement a control system
- Select and integrate sensors and actuators into a mechatronic system
- Implement intelligent robotics algorithms, including image processing and motion
- Manage a project to deliver a working solution based on the requirements
- Demonstrate effectively the ability to work in a group with students from various technical backgrounds

WHAT DOES THE COMPETITION INVOLVE?

The competition is designed to test various common facets of robotics applications including:

Localisation – Knowing the robot's position within a certain map is essential if the robot is required to move within the map. The competition is based on a large track – 6m x 4m.

Obstacle Avoidance – Avoiding obstacles is another key element of the design.

High Speed Algorithm – A key element of this year's competition is speed. Therefore, the designs are required to implement:

- High speed sensor fusion
- High speed decisions
- High speed localisation

KEY DATES

January 2018:	Introduce the competition and open applications for 2017 competition.
3rd April:	Applications due
6th April:	Teams finalised
9th April:	Competition begins. Detailed competition requirements and development kits provided to all competing teams, and training schedule with NI mentor defined.
26th April:	Milestone 1
9th May:	Milestone 2
8th June:	Milestone 3
25th July:	Milestone 4

29th August:	Milestone 5
3 September	Milestone 6
18 September:	National Final – Live Competition in University of Technology Sydney

REQUIREMENTS

Milestones

All participating teams must complete all 5 competition milestones in order to qualify for the live final competition.

Online Training

- **Online NI LabVIEW Training Course (Core 1 and Core 2)** *

The first step in any NI LabVIEW learning path, LabVIEW Core 1 gives you the chance to explore the LabVIEW environment, dataflow programming, and common LabVIEW development techniques in a hands-on format. In this course you will learn to develop data acquisition, instrument control, data-logging, and measurement analysis applications. At the end of the course, you will be able to create applications using the state machine design pattern to acquire, process, display, and store real-world data.

The LabVIEW Core 2 course is an extension of the LabVIEW Core 1 course and teaches you to use common design patterns to successfully implement and distribute LabVIEW applications for research, engineering, and testing environments. Topics covered include programmatic control of your user interface, techniques to optimize reuse of existing code, use of file I/O functions, and tools to create executables and installers. This course directly links LabVIEW functionality to your application needs and provides a jump-start for application development.

---

*This training course is mandatory for all team members and is part of the milestones needed to advance in the competition.

- **Introduction to LabVIEW, NI myRIO and Data Acquisition session**
  This training is designed to get you started with the LabVIEW environment and configuring and also programming the NI myRIO. This training will help you understand the fundamentals of graphical programming with LabVIEW, the key steps in system configuration and hardware integration, familiarize yourself with building data acquisition applications and connecting sensors and leverage graphical programming to build stand-alone, deterministic embedded systems with NI myRIO.

- **Control and Design Simulation Session**
  In this training, learn to construct transfer functions and build systems, explore how to get system response and analyse model behaviour, compute time domain specifications, design and develop control algorithms, how to use the MathScript node, how to simulate a control algorithm and understand the response of a system with different control gains. Finally, use these functionalities to build real-time control systems using NI myRIO.

- **LabVIEW Robotics Toolkit Session**
  Robots mean many things to many people, and NI offers intuitive and productive design tools for everything including designing autonomous vehicles. Also, the LabVIEW Robotics module contains a large number of functions robot design. In this session, you will explore how Robot design is made easy with LabVIEW and NI Hardware. Learn how to integrate hardware systems using the NI myRIO platform.

- **Tips and Tricks for LabVIEW Programming Session**
  This session will describe many different tips and tricks for programming faster in LabVIEW and ultimately faster robot design. Learn about the productivity-accelerating features in LabVIEW, how to best utilize templates and sample projects (including how to create your own) to provide time-saving starting points for LabVIEW applications, accelerate common tasks in the LabVIEW editor and many more.

As part of the competition requirements, at least 1x team member must attend all online training sessions.

Attend all five online training courses and the attendee will receive a certificate of completion from NI.

MILESTONES

Milestone 1: (25th of April)

Completion of the Online NI LabVIEW Training Course (Core 1 and Core 2) by all team members.

Milestone 2: (9th of May)

Submit Project Proposal (300-500 words in MS Word or MS PPT format)

Demonstrate usage of NI myRIO and LabVIEW to control at least one actuator/motor or acquire from at least one sensor.

Milestone 3: (8th of June) * *LabVIEW Code submission and review will be required from Milestone 3-6*

Requirement: Preliminary design and prototype with obstacle avoidance implemented.

Demonstrate: Create a prototype that moves forward avoiding obstacles.

Milestone 4: (25th of July)

Requirement: Demonstration of navigation/localisation and obstacle avoidance.

Demonstrate: Move from location A to location B while avoiding obstacles. Then at location B, wait a few seconds then move to location C.

Milestone 5: (29th of August)

Requirement: Navigation and obstacle avoidance.

Demonstrate: Move from location A to location B avoiding obstacles. Then from location B, move to location C speeding through a curve. Then go back to location A through an uneven terrain.

Milestone 6: (3rd of September) Requirement to Qualify for Finals.

Requirement: Building an executable

Demonstrate: Package your entire code into an executable and deploy a "start-up VI" onto myRIO so that the program will be auto-loaded when myRIO is powered on.

** At least one team member must attend all online training sessions to qualify for the live final.*
**Code submission and review will be required to pass Milestones 3-6.*

EACH TEAM WILL BE PROVIDED WITH:

- NI myRIO embedded measurement and control platform (www.ni.com/myrio)
- Software - LabVIEW 2017 Robotics Software Suite (www.ni.com/labview)
- Samples of the competition materials will be provided to the teams for reference
- Technical Support: access to advice and support from designated NI Applications Engineers
- Access to NI Online Training Courses
- Eligibility to take the Certified LabVIEW Associate Developer (CLAD) Exam after the competition. Students can get an NI Certification which is recognised in industry along with over 19,000 certified scientists and engineers worldwide.

Please visit www.ni.com/robotics for more information about the hardware and software solutions provided for the competition.

ACADEMIC SUPERVISOR TESTIMONIALS

"The NIARC has been a great way to have students apply their knowledge to solve topical problems. It is interesting to see what they come up with and the solutions that students at other universities develop. Sometimes students do not see how the theory they are taught at university can be used in real world applications. This competition goes a long way to bridging that gap. "
– Nathan Larkin, Team UoW, University of Wollongong

"The students that I have supervised since the inception of the competition have thoroughly enjoyed the challenge of competing in the NIARC. The competition provides the students with an opportunity to showcase both their analytical and implementation skills in a simulated real-world environment. Many of the students involved in the competition have moved out to industry and have used the NIARC experience as part of their application and interview."
-Glenn Matthews, RMIT Ferrum Carrus, RMIT

LIVE COMPETITION

A live national competition will be held on 18 September 2018 in University of Technology Sydney, Australia, with all teams competing to complete the required tasks in the shortest amount of time.

Participation at the live national competition will only be permitted to teams that have achieved all competition requirements.

For more information about the competition, visit **australia.ni.com/ni-arc.**