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Junior Skills Malaysia (JSM) Online 2021

TECHNICAL DESCRIPTION

MOBILE ROBOTICS

The Technical Description consists of the following:

1. INTRODUCTION

1.1. NAME AND DESCRIPTION OF THE COMPETITIONS

The name of the skill trade is Mobile Robotics

1.2. Description of the associated work role(s) or occupation(s).

Mobile Robotics is a fast evolving, solutions orientated, industry within which the robotics technician/ engineer has a significant and growing work role. Robotics now forms an important part of many industries, with applications in diverse sectors, including manufacturing, agriculture, aerospace, mining, and medicine.

A robotics technician or engineer can work in offices, manufacturing plants or laboratories – basically anywhere the mobile robots may be needed. He or she designs, maintains, develops new applications or robots and conducts research to expand the potential for these robots. The role begins with a strong focus on a specific business problem, in a particular sector. For example, in manufacturing there may be a need to increase capacity by creating robots for tasks that can be automated. Mobile robots may also be designed to explore areas that are inaccessible or dangerous for human beings.

Careful and detailed client consultation is required, resulting in an accurate specification so that the aim and objective of any robotic solution is clear. The design phase follows, and a prototype is assembled. The robot is then programmed and tested to ensure a high, consistent performance. At the heart of every robot is a robotics technician/engineer who thinks about what a robot needs to do and works with several engineering disciplines to design and put together the optimal piece of equipment, demonstrating a commitment to attention to detail. In this instance the robotics technician/engineer uses existing technologies to create solutions to new challenges by bringing them together in a way that has not previously been done.

Robotics technician/ engineers must be familiar with logic, microprocessors, computer programming, mechanical, electrical, and control systems so that they can design the right robot for each application. They must also prepare specifications for the robot's capabilities as they relate to the work environment. In addition, robotics technician/engineers are responsible for cost efficient design, cost- price calculations and quality-control. Integral to the role of the high performing robotics technician/engineer are a range of soft skills that can be related and applied to any industry. Excellent communication and interpersonal skills, with a particular strength in working well in a team, are equally important.

An ability to be innovative and persevere creatively in problem solving challenges and generating solutions is also essential.

In an increasingly global industry, which is 'breaking new ground' and altering the way we live and work, there are significant opportunities for sustainable careers in robotics technician and engineering roles. The opportunities carry with them the need to work with diverse cultures, industries and fast paced technological change. The skills demonstrated, and the careers strived for can be developed in many areas and types of study from engineering and computer science, through to design, mathematics and the sciences. This can be through both academic and vocational study paths.

This skill covers various aspect of **designing, assembling and programming** a mobile robot to complete a given task. Practical, and theoretical knowledge is required to develop the robot. The major areas covered in this skill are: Basic electronics, sensor technologies, programming, mechanical design, motion mechanism, and planning.

1.3. Number of Competitors

Mobile robotic is a single competitor competition.

1.4. Age limit of Competitors

The Competitors must not be older than 15 years in the year of the competition.

1.5. Rounds

2 rounds consisting of a preliminary round and final round

2. COMPETENCY AND SCOPE OF WORK

The Competition is a demonstration and assessment of the competencies associated with this skill. The Test Project consists of practical work only.

2.1. Competency specification

- Understand the task
- Carryout planning
- Design robot mechanism
- Assemble robot to carryout task
- Programming of robot according to task
- Testing of robot
- Modifying and adjusting robot program
- Prepare report
- Presentation of result

2.2. Theoretical knowledge

Theoretical knowledge is required but not tested explicitly.

- The theoretical knowledge is limited to that necessary to carry out the practical work.
- Competitors should have general mobile robotics knowledge
- Competitors may be expected to use critical and creative thinking to solve problems.
- Competitors will be expected to have the ability to process information, produce documents and presentations related to the scenario.
- Competitors must have an understanding of robot controller and reasonable programming skills needed to undertake the project.
- Competitors must have an understanding of basic mobile robotic mechanism
- Competitors must have an understanding of sensors and actuators
- Competitors must have the ability to solve problems within the scope of this Technical Description.

2.2.2. Knowledge of rules and regulations is not examined.

2.3. Practical work

Competitors are expected to be able to do the following:

Problem-solving using creative and critical thinking to solve a given task using a choice of robot platform such as LEGO, VEX, Makeblock, Arduino base robot or any other suitable robot platform.

2.3.1. Design

The Competitor should be prepared to design their robot using the robot platform of their choosing and any additional components needed to complete a given task

The individual needs to know and understand:

- The principles and applications of project design
- The nature and formats of project specifications
- Design parameters can include the following:
  - Selection of components and parts
  - Assembly
  - Testing and Refinement
  - Commissioning
- Principles and applications for:
  - Designing and assembling mobile robotics systems
  - The components and functions of electrical and electronic systems
  - The components and applications of add-ons
  - The components and applications of mobile robotics systems
  - Principles and applications of design and assembly of mechanical, electrical and electronic systems, their standards and their documentation

- Principles and methods for work organization, control, and management in relation to the product.

The team shall be able to:

- Analyze the briefs or specifications to identify the required performance characteristics of the mobile robot
- Identify and resolve areas of uncertainty within the briefs or specifications
- Identify the characteristics of the environment in which the mobile robot is required to operate
- Identify hardware requirements to support the mobile robots' performance
- Develop strategies to solve mobile robotics tasks including navigation and orientation
- Generate innovative solutions to design challenges
- Identify and appraise options for selection of components and equipment
- Assemble, program and test robot
- Prepare technical report
- Complete the task within given limits and time

2.3.2. Assembly

This module will assess the ability of the competitor to assemble their robot. Competitor will use their own kit and need to assemble the robot from scratch so that the robot can perform the given task.

The team shall be able to know and understand:

- Basic principles of mechanical, electrical and electronics, and technician/engineering
- Principles of assembly (physical)
- Principles and practices of safe manufacture and operation

The team shall be able to:

- Integrate the structural and mechanical parts of the mobile robot
- Integrate the electronic control circuits
- Install, set up and make all necessary physical and software related

adjustments required for effective use

- Install, set up and make all necessary adjustments to the mechanical, electrical and sensor systems
- Install, set up and make all necessary adjustments required for effective tele-operation of the mobile robot
- Integrate sensors to gain control of the required tasks.

2.3.3. Programming, testing, and adjustment

This module will assess the ability of the competitor to develop the program for the robot and carryout testing to test their robot programming thus make adjustment if necessary

The team shall be able to know and understand:

- Manufacturers' control software (for programming of robot)
- How to program using standard software
- How a software program relates to the action of machinery and systems
- Principles and applications of wireless/wired communications
- Sensor integration
- Analytical techniques for fault finding
- Techniques and options for making adjustments and repairs
- Strategies for problem solving
- Principles and techniques for generating creative and innovative solutions

The team shall be able to:

- Visualize the process and operation using software
- Use standard programming software to assert effective remote and autonomous control over the robot's movement
- Use tele-operation to assert effective control over the robot
- Implement programming methodologies to the control systems
- Install and make physical settings adjustments to sensors
- Test run individual applications and full functionality
- Find and document faults using appropriate analytical techniques

- Demonstrate basic IT knowledge
- Repair or change components efficiently
- Demonstrate the movement of their robot

2.3.4. Program modification

This module will assess the ability of the competitor to modified their robot program according to the modified task given and within the given time limit.

The team shall be able to know and understand:

- Understand the modified task
- Strategies for problem solving
- Principles and techniques for generating creative and innovative solutions

The team shall be able to:

- Use standard programming software to assert effective autonomous control over the robot's movement
- Implement programming methodologies to the control systems
- Test run individual applications and full functionality
- Find and document faults using appropriate analytical techniques
- Repair or change components efficiently
- Demonstrate the movement of their robot

3. ASSESSMENT

This section describes how the Experts will assess the Test Project / modules. It also specifies the assessment specifications and procedures and requirements for marking. The Assessment is done in two rounds which are the preliminary round and final round. Competitors will be chosen to advance to the final round

3.1. Assessment criteria

This section defines the assessment criteria and the number of marks (subjective and objective) awarded. The total number of marks for all assessment criteria must be 100. For the preliminary round, two aspect is assessed which is the robot performance and technical robot. For the final round, only the performance of the robot is assessed.

3.2. Subjective marking

- Not applicable

3.3. Skill assessment specification

The skill assessment criteria are clear concise aspect specifications which explain exactly how and why a particular mark is awarded. (The following is not a definitive list but rather examples of the aspects included in each criterion.)

3.3.1. Robot performing task

- The robot completely out of the start/finish box
- The robot moves to pickup area
- The robot successfully lifted the first seed
- The robot successfully lifted the second seed
- The robot successfully lifted the third seed
- The robot successfully lifted the fourth seed
- Robot successfully carries the fourth seed in 1 meter
- The robot managed to put the first seed in right places
- The robot managed to put the second seed in right places
- The robot managed to put the third seed in right places

- The robot managed to put the fourth seed in right places
- Autonomous(bonus)
- Total time starting robot move out and return to the finish box

3.3.2. Technical Report

- Acknowledgement.
- Project Mission, Vision & Objective.
  - Background.
  - Robot functionality.
  - Uniqueness and interactive behavior.
- Designing and Building Process:
  - Concept and Implementation.
  - Engineering and stability of the structures.
  - Pictures of the project (at each stage).
  - Final model and pictures depicting different angles.
- Programming:
  - Printed programming with explanations.
- Project Conclusion with team photo (competitor and participant)

3.3.3. Reprogramming of robot

- Reprogramming of robot according to a modified task that is given and fulfill all criterion in 3.3.1
- Robot moves autonomously
- Reprogramming / modifying robot within the given time limit

3.4. Presentations

- Preliminary – round
  - Competitor needs to upload an unedited video of the robot performing task before the given dateline through Youtube or google drive (please provide the url / link)
  - Competitor needs to upload a technical report according to the given format

- Final – round
  - Competitor needs to upload an unedited video of the robot performing task within the given time frame through Youtube or google drive (please provide the url / link)

3.5. Skill assessment procedures

The marking scheme for each module should be objective and normalized.

The Experts will decide together on the Test Project and the marking criteria on the marking summary sheet. The Experts will agree on the final marking scheme.

Each Test Project module will be marked by the Experts. They will decide together, according to the marking scheme, on the mark to be allotted for every task carried out by every competitor for that particular module.

A sample marking scale and instructions for referees is to be included in each module. Experts/Referees are to complete a Marking Sheet for each module completed, for each team.

The rules for all modules will require all Competitors to focus on maximizing their own score.

For the preliminary round:

Assessment is based on the degree to which a Mobile Robot is able to complete the various competition tasks taking into consideration pre-set performance efficiency standards as the core evaluation criteria and the time taken by the robot to complete the given task.

This is judged base on the video uploaded by the competitor

The competitor will also be assessed on the technical report they submitted.

For the final round:

Assessment is based on the degree to which a Mobile Robot is able to complete the modified competition tasks and the time taken by the robot to complete the modified given task.

This is judged base on the video uploaded by the competitor

4. MATERIALS & EQUIPMENT

4.1. Infrastructure List

The Infrastructure List details all equipment, materials and facilities needed either provided by the competitor or the organizer.

The Infrastructure List specifies the items and quantities required for competitor to participate in this competition. The Competition Organizer will progressively update the Infrastructure List specifying the actual quantity, type, brand, and model of the items.

Bellow are the list of the list of material and equipment needed

1. Robot platform from either LEGO, VEX, Makeblock, Arduino or any suitable robot platform including any additional mechanical or electronic parts needed to complete the task including its programming software
2. Gamefield Materials (Standard table tennis ball – minimum 4 pcs, Standard 500ml mineral water bottle cut into two – minimum 4 pcs,Standard rubber band (approximately 50mm in diameter) – minimum 4 pcs, White / black line for marking and for autonomous guidance (if applicable))
3. Computer / laptop / any device that can be used for programming robot
4. Web camera
5. Handphone or any recording device to record the video
6. Watch to display time (need to be visible in video)
7. Measuring tape
8. Online video conference platform

4.2. Competitor's Toolbox

Competitors can bring a toolbox if applicable

4.3. Materials, equipment and tools supplied by Competitors in their toolbox

As required (not restricted). Competitors need to have all the tools and parts needed to assemble the robot and program the robot.
Measurement tools or any other tools to support the development of the robot are also is permitted pending approval from the experts

4.4. Materials, equipment and tools supplied by Experts

Not applicable.

4.5. Materials & equipment prohibited in the skill area

Not applicable.

5. SKILL-SPECIFIC RULES

Skill-specific rules cannot contradict or take priority over the competition Rules. They do provide specific details and clarity in areas that may vary from competition to competition. This includes but is not limited to personal IT equipment, data storage devices, internet access, procedures and work flow, and documentation management and distribution.

TOPIC/TASK	SKILL-SPECIFIC RULE
Communication and contact between compatriot Trainer, Digital Workshop Manager and Competitor	• During preliminary round, communication between trainer/ coach and is permitted for guidance only • During the final round, no communication between Workshop Manager/ trainer/ coach and competitor all the time unless required
Use of technology – personal laptops, tablets and mobile phones	• Competitors are allowed to use laptop / computer / tablet and mobile during competition for programming of robot
Use of technology – personal photo and video taking devices	• Competitors, are allowed to use personal photo and video taking devices mobile during competition (to record video for submission only)
Use of remote access	• Use of remote desktop / remote access to the competitor's computer / laptop / device (for programming) is not allowed (especially during final round)
Templates, aids, etc.	• Competitors are allowed to bring and use aids for positioning their robot.

Drawings, recording information, datasheet, manual	• Competitors can bring all kinds of information on paper and/or digital during competition • Competitors may gather new information during the competition over the internet and/or by consultation. • The use of online storage services, such as Dropbox or GitHub are not permitted.
Equipment failure	• Equipment is a responsibility of the teams. Replacement components during the Competition Days will NOT be provided by the Sponsor. Teams are responsible for bringing their own spare parts.
Health, Safety, and Environment	• Refer to the WorldSkills Health, Safety, and Environment policy and guidelines document.
Toolbox Size	• Competitors can bring a toolbox if required
Use of Competition Fields	• Competition Fields is the responsibility of the competitor

6. APPENDIX

6.1. Proposed Competitor Workstation Layouts