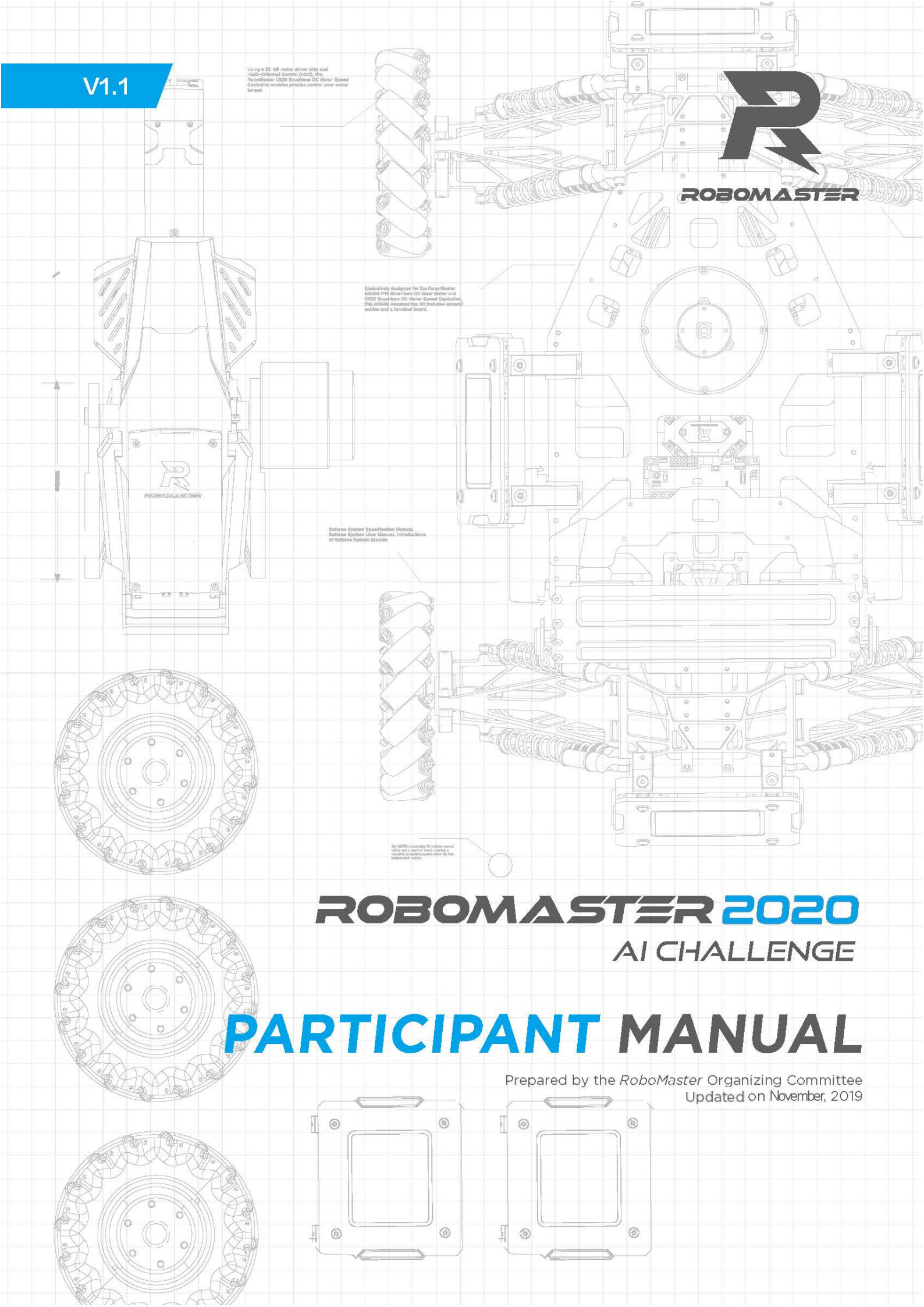
V1.1



ROBOMASTER

ROBOMASTER 2020

AI CHALLENGE

PARTICIPANT MANUAL

Prepared by the *RoboMaster* Organizing Committee

Updated on November, 2019

Reading Tips

Symbol Descriptions

Prohibition	Important	Hits and Tips	Reference

Release Notes

Date	Version	Changes
2019.11.22	V1.1	1. Update season schedule 2. Add participation support 3. Add selection details of Academic Incentive Award
2019.10.15	V1.0	First Release

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Table Directory

1. Foreword

Group and Organization

Host

- IEEE RAS International Conference on Robotics and Automation 2020, ICRA 2020
- DJI (Shenzhen) Technology Co., Ltd. (DJI, Dà-Jiāng Innovations)

Organizer

RoboMaster Organizing Committee

2. Season Schedule

⚠ The following is the RoboMaster 2020 Robotics Season Schedule for reference only. The specific time is subject to the latest announcement by the RMOC.

Table 2-1 Season Schedule

Schedule	Item	Channel	Notes
October 15, 2019 – 12:00 December 25, 2019	Registration on Official Website	Log in the RoboMaster website and complete the registration as required	Successful registration allows participants to obtain a discount on the purchase of materials
October 15, 2019 - 12:00 January 15, 2020	Material Purchasing First Batch	Online purchasing, Offline purchasing	Purchase materials according to the material purchase announcement published on the official RoboMaster website
February 10, 2020 - April 15, 2020	Material Purchasing Second Batch	Online purchasing, Offline purchasing	
October 15, 2019 – 12:00 December 25, 2019	Technical Assessment – Technical Proposal	By registering and obtaining registration numbers, teams can use the their captains' accounts to log in to the competition registration system to submit for Technical Assessment	• Optional • Teams with excellent technical proposals can receive robots or robot purchasing coupons sponsored by the Organizing Committee
January 15, 2020 – 12:00 March 20, 2020	Technical Assessment – Technical Report		• Required • Only teams with passed technical reports are eligible to enter the AI Challenge • Teams with excellent technical reports can receive funding subsidies
April 1, 2020	Announcement of Entry List	RoboMaster official website	The final competing teams may receive funding subsidies

Schedule	Item	Channel	Notes
June 1, 2020	Registration Day and Practice Matches	Paris, France	-
June 1, 2020 – June 3, 2020	Official Competition		Includes the Group Stage and the Knockout Stage

The time of official competition is the time standard for the venue of the competition, and for other schedules it is UTC+8 (Beijing time) standard.

3. Participate

3.1 Requirement for Participant

Below shows the requirement for participants:

Table 3-1 Requirement for Participant

Position	Position Description	Qty.	Qualification	Duties
Supervisor	● Provide strategic, technical and management support and guidance to the team ● Cannot serve as Advisor or team member at the same time	1-2	Faculties of the team's college or university who are qualified for teaching and scientific research before August, 2020	Advisor can undertake tasks of manufacturing robots and other competition affairs
Team Member	Including Captain, General Member and Project Management, see the table below for more details	4-12	Full-time junior college students, undergraduates, postgraduates, and doctoral students in colleges and universities before August 2020	See the table below for more details

Table 3-2 Requirement for Team Member

Position	Position Description	Duties
Captain (one person only)	● Key member of the team, responsible for technology and tactics ● The major liaison for the RMOC ● Cannot serve as OPM or Advisor at the same time	● Responsible for division of labor, overall planning and tactics arrangement and adjustment ● Attend Captains Meeting, represent the team to confirm match results and participate in appeal processes and any subsequent hearings ● Responsible for the heritage and development of the team after the competition
General Member	Technician	● Algorithm group: program development (recommended 2-8 people) ● Mechanical group: mechanical structure maintenance (recommended 1-2 people)

Position	Position Description	Duties
		● Embedded group: interface call and program development (recommended 0-2 people)
Project Management	Oversees the RoboMaster project by managing project schedules, budgets, and personal safety	The Project Manager oversees the entire project. The Project Manager's responsibilities include: managing the project's overall progress, comprehensively considering R&D costs, work safety and other issues and making overall management decisions (e.g. progress, outcomes, costs, etc.)

3.2 Platform for communication and Q&A

The RMOC provides many Q&A channels as shown below: For more contact information of the Organizing Committee, please refer to the official channel summary of the RMOC.

Table 3-3 Platform for communication and Q&A

Channel	Notes	Office Hours
Official BBS: bbs.robomaster.com	In the "Event Information" version of the "AI Challenge" section, the [AI Challenge Rules Q&A] is used as the title prefix. The organizing committee will regularly check and reply on Thursday-Friday	Working day 10:30-12:30, 14:00-19:30
Email: robomaster@dji.com	Send an email with the subject of the [AI Challenge Rules] as the subject prefix. The organizing committee will periodically check and reply on Thursday-Friday	
Tel：0755-36383255	-	

3.3 Participation Support

Teams are entitled to the following participation support:

Table 3-4 Participation Support

Criteria	Support
Successful registration	Entitled to purchasing AI robots at first-tier discounted prices
Passing the Technical Proposal	● Grade A: Receives an AI robot ● Grade B: Entitled to purchasing AI robots at tier-two discounted prices

Criteria	Support
	● Grade C and above: Entitled to leasing AI robots
Awarded with an Outstanding Technical Report	Receives funding subsidy of USD $ 1,000
Other Support	● Entitled to purchasing materials required for the competition at education discounted prices ● Delivery fee and taxes waived for purchases of official materials ● Comprehensive support for areas including team operations, business management, publicity, project management and technical development

4. Award System

Award is as follows:

Table 4-1 Award System

Award	Ranking	Qty.	Reward
Grand Prize	First Place	1	● Honorary Certificate (for each team member) ● Cash reward USD $ 20,000 (pre-tax)
First Prize	Second Place	1	● Honorary Certificate (for each team member) ● Cash reward USD $ 10,000 (pre-tax)
	Third Place	1	● Honorary Certificate (for each team member) ● Cash reward USD $ 5,000 (pre-tax)
	Fourth Place	1	● Honorary Certificate (for each team member)
Second Prize	Fifth to Eighth Place	4	● Honorary Certificate (for each team member)
Third Prize	The teams that entered the AI Challenge but failed to enter the quarterfinals	Multiple	Honorary Certificate (for each team member)
Participation Award	The teams that got rank C in the Technical Report (No qualification to the competition)	Multiple	Honorary Certificate (for each team member)
Academic Incentive Award	Research results related to the AI Challenge are developed into papers and published in academic journals	Multiple	● Highest Cash reward USD $ 10,000 (pre-tax) ● Honorary Certificate (for each team member)

- Supervisors and Advisors for the winning teams will also receive the corresponding Honorary Certificate.
- Academic awards are assessed based on factors such as journal impact factor, zoning, and the impact of international conferences. Details of the assessment will be detailed in subsequent rules.

Appendix 1 Technical Assessment

Technical Assessment will be graded according to certain requirements and the grade will be displayed in the registration system. The following shows the relation between scores and grades:

Table 4-2 Rating system

Score	Level
90 ≤ X ≤ 100	A
75 ≤ X < 90	B
60 ≤ X < 75	C
0 ≤ X < 60	D

Technical Proposal Assessment Specifications

After reading the rules and the official robot manual, use the block diagram and text to describe the hardware and software system structure for a robot that can complete the competition.

Technical Proposal

- Submission Form: a PDF file, containing all pictures, text and video link addresses (passwords included).
- Font: Microsoft YaHei (Chinese) or Times New Roman (English) in size 12
- File Size: No more than 10 pages of A4 paper
- File Name: school name + team name + AI Challenge Technical Proposal
- Others: Video display is encouraged. Teams can upload encrypted videos on YouTube or other online platforms, and indicate the video link addresses and corresponding passwords in their reports.
- Assessment standards: Teams are required to explain their robot system and technology implementation from the following aspects.

  Table 4-3 Technical Proposal Assessment Standards

Module	Content
Hardware	● Sensor type and usage, combined with parameters to explain the reasons for such choice. ● Computing device selection (including AI robot onboard computer and computer connected to the Sentry), explain the reasons for selection according to device parameters.

Module	Content
	● The communication hardware link analysis. Consider the choice of communication links and methods among controllers, onboard computers and sensors inside AI robot, AI robot system and Sentry system, and explain the reasons for such choice.
Software	● Explain the functional modules and planned algorithms required to complete the competition. Analyze and consider them one by one in terms of AI robot perception system, obstacle avoidance for motion planning, motion strategy for Buff/DeBuff zones, gimbal in servo control during automatic firing, and perception system for Sentry. Point out the advantages and disadvantages of relevant algorithms. Explain the key problems that different modules may encounter and analyze the bottlenecks of their respective solutions. ● Describe the plan for decision-making and overall deployment of different functional modules. Explain the reasons for such choice, the key problems that may be encountered and analyze the bottlenecks of their respective solutions ● Analyze system debugging process, problems and solutions for the design of the interaction and visualization interface of the entire platform system  It is recommended that the participating teams list each team member's learning, research or competition experience related to robot systems and the above algorithms. Relevant projects, papers or videos can be listed for reference.

Technical Report

Technical reports include the video display section and the written description section. The following are the specific requirements for the two sections.

A. Video display

- Others: Video display is encouraged. Teams can upload encrypted videos on YouTube or other online platforms, and indicate the video link addresses and corresponding passwords in their reports.
- Video Standard:
  - A title that includes the college name and date/place of the recording must be displayed at the beginning of the video.
  - It is recommended to record the video in a place with sufficient lighting so as to best display every operation and movement.
  - Do not include meaningless scenes in the video, accelerate the display of non-key content. Make sure the whole video is concise and clear, and the duration is under 10 minutes.

- It is recommended to take multiple clips of different tasks and edit these clips within reasons to ensure the readability of the entire video. Misleading special effects or post-processing are strictly prohibited.

- Teams need to film and describe the sensors they use, and the tasks shown must include but are not limited to:

Each section requires a title caption. Subtitles can be added for description if necessary.

  - Robot localization, motion planning towards Buff zone with obstacle and DeBuff zone avoidance.
  - Identifying different armors of moving robots and performing firing or chasing tasks of specific armor.
  - Global perception task for Sentry visual system and communication with AI robot.
  - Performing the entire competition process under the referee system server configurations, including the automatic startup during the competition, occupying the projectile supplier buff zone, independent firing and confrontation with the enemy robots, as well as coming back to starting zone when game ends, etc.
  - Visual interaction and debugging interface for system platform

B. Written Description

- Submission Form: a PDF file, containing all pictures, text and video link addresses (passwords included).
- Font: Microsoft YaHei (Chinese) or Times New Roman (English) in size 12
- File Size: No more than 10 pages of A4 paper
- File Name: school name + team name + AI Challenge Technical Report
- Teams are required to explain their robot system and technology implementation from the following aspects.

Table 4-4 Technical Report Assessment Specifications

Module	Content
Hardware	● Mechanical Structure ➢ A description of the mechanical changes based on the official AI robot, as well as the layout for each actuator, sensor, arithmetic unit, and communication link between them. ➢ Design instructions for the mechanical interface of camera on the Sentry. ● Sensor

Module	Content
	➢ Indicate the sensor type and sensor parameters used. For example, when it comes to cameras, the shutter type, resolution, field of view, maximum frame rate, etc. should be indicated. While for radar, its maximum measurement angle, the number of sampling points per second, measurement accuracy and the maximum frame rate, etc. should be indicated, as well as the reasons for the choice and requirements of the corresponding algorithm. ➢ Indicate the sensor parameters of the monocular camera used for the Sentry ● Indicate the type and parameters of the computing device used, and analyze the reasons for the choice in terms of program performance. ● Describe other communications or other equipment used and analyze the reasons for the selection.
Software	Teams are required to provide a system diagram to describe the software system for their robots, and explain technical solutions of the software from the following aspects: ● Automatic Recognition ➢ Describe the sensors and corresponding algorithms used, and explain the superiority of the algorithm from the aspects of different armor recognition, high-speed motion recognition, precision ranging and robot pose estimation, etc. ➢ Point out the performance of the algorithm, such as target recognition accuracy, frame rate and distance precision. If a learning scheme is adopted, it is necessary to point out the referenced algorithm, network architecture and learning framework employed. ● Localization ➢ Describe the sensors and corresponding algorithms adopted, and explain the superiority of the algorithm from the aspects of random initial locating and high-speed motion locating. ➢ Point out the performance of the algorithm, such as the locating precision, frame rate, and so on. ● Motion Planning

Module	Content
	➢ Describe the obstacle avoidance sensors adopted and corresponding algorithms. Introduce the superiority of the algorithm used from the aspects of path planning, trajectory planning, and multi-robot motion planning. ➢ Point out the performance of the algorithm, such as the frequency of planning, maximum motion speed, obstacle avoidance ability and so on. ● Automatic Firing ➢ Describe and recognize the gimbal control algorithm adopted by automatic firing under algorithm integration, and illustrate the superiority of the algorithm from the following aspects of firing under high acceleration motion. ➢ Point out the performance of the algorithm, such as the farthest strike distance, the strike precision, and so on. ● Global perception system of the Sentry: Describe the vision system scheme and function used by the Sentry, mainly describing the tasks implemented, the algorithms used, the way of communicating with the robot, and the strategy of assisting the AI robot system. ● Intelligent Decision: Describe the framework for decision making ➢ If you use traditional methods (such as finite state machines or behavior trees), you need to draw a running logic diagram; if you use a learning based solution, you need to point out the algorithm, network architecture, and learning framework used. ➢ The introduction process needs to be explained in conjunction with the execution flow of the video presentation. The simulation environment can help explain but not as a key material. ● Visual interaction and debugging system: Describe the functions of visual interaction and debugging interface, analyze the debugging process for robots during the preparation, test methods and problems from different modules solved by the debugging system

Appendix 2 About Award Selection

Academic Incentive Award

a) Selection Rule

Teams that meet all the following criteria may apply for the RoboMaster AI Challenge Academic Incentive Award through the application process before 12:00 (UTC+8) on May 1, 2020. The successful team will receive a maximum cash reward of USD $ 10,000 (pre-tax) and honorary certificate (for each member).

- The team has successfully registered to participate in the RoboMaster 2020 AI Challenge.
- The team has purchased RoboMaster AI robots before.
- The team has presented or published a paper (including having had it accepted) at a robotics-related international conference (including but not limited to ICRA, IROS and RSS) or journal (including but not limited to IJRR, JFR and TRO).
- The published paper must contain the use of all or some of the parts on the RoboMaster AI robot platform, and have successfully tested an algorithm or innovated on its application.
- The paper must involve content related to RoboMaster competitions and platform.

Note: The relevance and rating of the research findings will be determined by the RoboMaster Organizing Committee.

b) Application Process

1. Fill in the “RoboMaster 2020 AI Challenge Academic Incentive Award Application Form”.
2. Send the following three documents to the Organizing Committee’s email: robomaster@dji.com

- “RoboMaster 2020 AI Challenge Academic Incentive Award Application Form”
- Relevant content of research findings (PDF/JPG)
- Proof of presentation or publication of research findings (e.g. scans of the research findings published in the journal/online publication links/official certificates/email acknowledgements of acceptance, etc.)

3. Await review and confirmation of the Organizing Committee. The outcome will be announced within 15 working days of submission of materials.

Note: If any material is missing or the review cannot be completed, the Organizing Committee reserves the right to require the applicant to provide more information. The period of review will be calculated from the last submission of materials.

If the applicant has no objections to the review outcome, it will be announced on RoboMaster’s official website for 3 working days from May 15, 2020. After the announcement period, the Organizing Committee will present the award at the RoboMaster 2020 AI Challenge prize-giving ceremony based on the outcome

announced.

c) Prize Level

Table 4-5 Academic Incentive Award Prize

Prize	Qty.	Notes
• **Cash reward of USD $ 10,000 (pre-tax)** • **Honorary Certificate (for each member)**	1	The judging criteria will be based on aspects such as academic, educational and practical value. The Organizing Committee will score the candidates and determine the winner, on which it reserves the final right of interpretation.
• **Cash reward of USD $ 2,500 (pre-tax)** • **Honorary Certificate (for each member)**	2	
• **Cash reward of USD $ 1,000 (pre-tax)** • **Honorary Certificate (for each member)**	5	

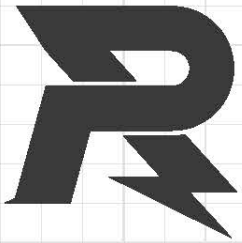
RoboMaster 2020 AI Challenge Academic Incentive Award Application Form

Main applicant's name		Team Name		University/college	
Research findings Format		Relation of main applicant with research findings	□First author □Joint first author □Corresponding author □Others_____		
Name of journal/ conference			Title of paper/ subject		
Date of publication/ time of receipt		Is the relevant code open-source?		Open source address (if applicable)	
Description of research findings (research abstract, conclusion, applications, etc.)					
Relevance to RoboMaster AI Challenge					

Other authors of the research findings	Name	Relation with the findings	Organization	Participated in the RoboMaster 2020 AI Challenge?

***The following will be filled in by the RoboMaster Organizing Committee, and does not need to be filled in by the applicant. They are for the applicant's reference only.**

Organizing Committee's score	**Academic value score**	**Educational value score**	**Practical value score**	**Total score**
Organizing Committee's remarks				



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