



THE WARSAW UNIVERSITY OF TECHNOLOGY

Resolution No. 2/2024 of the Scientific Council of the Research Centre for the Priority Research Area Artificial Intelligence and Robotics of 27 April 2024

on the announcement of the SzIR-RP2 competition, as part of the implementation of the “Excellence Initiative - Research University” programme at the Warsaw University of Technology

Pursuant to § 7, section 2, items 2 and 3 in connection with § 4, section 2, item 6 of the Regulations for Research Centres for Priority Research Areas (POB) of the Warsaw University of Technology, constituting an annex to Decision No. 38/2020 of the Rector of the Warsaw University of Technology of 26 February 2020 on the establishment of Research Centres for Priority Research Areas (POB) as part of the implementation of the “Excellence Initiative - Research University” programme at the Warsaw University of Technology, it is resolved as follows:

§ 1

1. As part of the implementation of the “Excellence Initiative - Research University” programme at the Warsaw University of Technology, within the scope of the implementation of the strategy for the development of the SzIR POB, a competition titled: “SzIR Precision Farming 2”, hereinafter referred to as “SzIR-RP2 competition”, is hereby announced.
2. The SzIR-RP2 competition shall be conducted according to the rules specified in the Regulations for the SzIR-RP2 competition, hereinafter referred to as the “Regulations”, constituting an annex to the Resolution.

§ 2

1. The competition referred to in § 1 shall be announced on 6 May 2024.
2. The closing date for teams taking part in the competition is 7 June 2024.
3. The closing date for submitting a description of the proposed solution is 2 September 2024.
4. The SzIR-RP2 competition shall be resolved by 15 October 2024.

§ 3

The resolution enters into force upon its adoption.

Chairperson of RN CB POB
Artificial Intelligence and Robotics

Professor Cezary Zieliński

Opinion given at BOP.
Edyta Olszewska
Solicitor
BOP 1539



Annex to Resolution No. 2/2024 of the Scientific Council of
the Research Centre for
the POB Artificial Intelligence and Robotics

REGULATIONS FOR THE SZIR-RP2 COMPETITION OF THE RESEARCH CENTRE FOR THE POB ARTIFICIAL INTELLIGENCE AND ROBOTICS

§ 1.

1. The SzIR-RP2 competition aims to popularise robotics research, in particular the use of robots in precision agriculture.
2. The competition task is to administer vaccines to diseased trees in an artificial orchard using an autonomous system comprising at least one robot. The details of the task are specified in Annex No. 1.
3. The SzIR-RP2 competition is funded by the POB Artificial Intelligence and Robotics.
4. The ShIR-RP2 competition refers to the development of a system to fulfil the task specified in section 2.
5. The system referred to in section 2 is to be devised by a team of up to three students of the Warsaw University of Technology, hereinafter referred to as “the team”.
6. The team shall submit a description of the solution by 2 September 2024 in the form of a draft of a scientific publication to a scored journal or a scored conference in the field of robotics or computer science.

§ 2.

1. The competition is open exclusively to students of the first- and second-cycle full-time degree programmes of the Warsaw University of Technology, who are members of a team.
2. The team applies for the SzIR-RP competition indicating its head, selected from among the team members, and a mentor - selected from among the academic staff of the Warsaw University of Technology included in the so-called N-number at the Warsaw University of Technology or PhD students at the Doctoral School at the Warsaw University of Technology, who will be the content advisor to the team.
3. The ShIR-RP2 competition will be annulled if fewer than four teams apply by the closing date for submitting teams (7 June 2024).
4. By entering the SzIR-RP2 competition, the participant shall declare that:
 - 1) he/she has read these Regulations and entered the SzIR-RP2 competition voluntarily;
 - 2) he/she agrees to and accepts the provisions of these Regulations;
 - 3) he/she shall comply with the provisions of the Regulations;
 - 4) he/she has given consent to the processing of personal data for the purpose of participation in the SzIR-RP2 competition.
5. By entering the SzIR-RP2 competition, you agree to transfer the proprietary copyrights in your entry.
6. An application prepared in accordance with the template in Annex No. 2 to the Regulations shall be submitted electronically using the online form available on the website www.badawcza.pw.edu.pl by 7 June 2024.
7. When unmanned aerial systems are used by a team, their pilot should have at least a licence in the category of Open A1/A3.

§ 3.

1. The competition entries are judged by a four-member committee appointed by the Scientific Council of the Research Centre for the Priority Research Area Artificial Intelligence and Robotics, hereinafter referred to as

- “RN CB POB SzIR”. The committee shall at the same time function as a jury in the competition show.
2. The Committee will nominate a chairperson from among its members.
 3. The jury members evaluating the competition entries must not be in any formal or factual relationship with the members of the proposed team and its mentor that might raise justified doubts as to their impartiality. If a member of the committee is in such a relationship with the team or the mentor, he/she is excluded from the evaluation of that competition entry.
 4. The criteria for the evaluation of the competition entries include:
 - 1) the innovation and scientific value of the proposed solution,
 - 2) the substantive quality of the draft publication, including a reference to the literature, a description of the innovative elements of the proposed solution, and its additional analysis, among other things,
 - 3) the efficiency of the system.
 5. There are two stages in the evaluation of competition entries:
 - 1) The first stage consists of an evaluation of each product and proposed publications by the members of the jury. The most highly evaluated competition entries are forwarded to the second stage. Whether or not a competition entry has been accepted for the second stage of evaluation shall be announced to the teams immediately after the decision of the evaluation committee.
 - 2) The second stage (competition show) consists of a presentation of the effectiveness of the system at the Przasnysz airport. Based on this, the commission will formulate the final evaluation of the competition entries.
 6. The result of the SzIR-RP2 competition will be announced on www.badawcza.pw.edu.pl by 15 October 2024.

§ 4.

A total of PLN 49,950 has been allocated for the prizes in the SzIR-PN competition:

- 1) for winning the first place - PLN 4,300 for each team member,
- 2) for winning the second place - PLN 3,850 for each team member,
- 3) for winning the third place - PLN 3,500 for each team member,
- 4) a prize of PLN 5,000 for the mentor of each team that has won a prize.

§ 5.

1. In publications, teams shall use the affiliation of the Warsaw University of Technology, which means that all publications must be signed with the clause:
 - 1) *Research was funded by POB Artificial Intelligence and Robotics of Warsaw University of Technology within the Excellence Initiative: Research University (IDUB) programme or*
 - 2) *Badania były finansowane przez POB Sztuczna inteligencja i robotyka ze środków Politechniki Warszawskiej w ramach Programu Inicjatywa Doskonałości – Uczelnia Badawcza (IDUB).*
2. All matters unregulated herein shall be settled by the Vice-Rector for Deelopment.

§ 6.

1. The safety of participants (teams) and spectators (i.e. observers) shall remain a priority during the competition show. Contestants are obliged to strictly adhere to these Regulations, including the instructions of the Organisers and the Show Director appointed by the Organiser. The Organisers trust that the contestants will act in accordance with the principles of fair play, in the spirit of sporting rivalry, while at the same time ensuring the safety of all participants. However, should a contestant notoriously break the rules, including in particular the safety regulations, the Organisers and the judges appointed by them shall have the right to disqualify



the participant or team and demand that they immediately leave the competition area. The same restriction shall apply to observers. Disqualification shall apply within a single competition or the entire competition. The competition shall not be subject to the requirements of the Act of 20 March 2009 on the safety of mass events due to the planned number of participants. However, the organisers declare that they will use the provisions of the Act in the organisation of the competition to increase safety.

2. The show shall only take place during the daytime, but strong wind or drizzle cannot be excluded.
3. The show shall take place at the WUT airport in Przasnysz on 27 September 2024.

§ 7.

In accordance with Article 13 of Regulation (EU) 2016/679 of the European Parliament and of the Council of 27 April 2016 on the protection of natural persons with regard to the processing of personal data and on the free movement of such data and repealing Directive 95/46/EC (Journal of Laws EU L 119/1 of 4 May 2016), hereinafter referred to as 'GDPR', Warsaw University of Technology informs that:

- 1) The Administrator of your data is the Warsaw University of Technology with its registered seat at pl. Politechniki 1, 00-661 Warsaw.
- 2) The Administrator has appointed a Data Protection Officer (IOD) within his/her scope to supervise the correctness of data processing. He or she can be contacted at the following email address: iod@pw.edu.pl.
- 3) The Administrator shall process your personal data to the extent of the data contained in the project application and the intermediate and final reports on the implementation of the project.
- 4) Your personal data shall be processed by the Administrator in order to implement Agreement 04/IDUB/2019/94 concluded on 30 December 2019 - the basis for the processing of your personal data is Article 6, section 1, point (b) of the GDPR.
- 5) The Warsaw University of Technology does not intend to transfer your data outside the European Economic Area.
- 6) You have the right to access the content of your personal data and the right to correct it, the right to request deletion, restriction of processing, and the right to object to the processing of your data. Due to the fact that the prerequisite for the processing of personal data is not consent, you do not have the right to data portability.
- 7) Your personal data shall not be disclosed to other entities (administrators), with the exception of entities authorised by law.
- 8) Your personal data may be accessed by entities ("processing entities") to which the Warsaw University of Technology commissions activities that may involve the processing of personal data.
- 9) The Warsaw University of Technology shall not use automated decision-making in relation to you, including your profiling.
- 10) The provision of your personal data is voluntary, however, failure to provide such data will prevent you from receiving research grant funding under CB POB competitions.
- 11) Your personal data will be processed for a period compatible with archiving category "A" of the documentation.
- 12) You have the right to lodge a complaint with the supervisory authority - the Polish Data Protection Commissioner - if you consider that the processing of your personal data violates the provisions of the GDPR.



TASK DESCRIPTION

1. The task assesses the system's remote sensing capabilities using machine learning and automatic selection systems. The task relates to precision agriculture and, in particular, the detection of plant disease pathogens and the precise dosing of plant protection products. The system should determine the following:
 - 1) How many apple trees are healthy?
 - 2) How many apple trees are on the verge of disease?
 - 3) How many apple trees are infected with powdery mildew and how many with scab?
2. The task is to inspect an imitation orchard consisting of 100 apple trees growing regularly over an area of 1 ha. The apple trees grow at intervals of 4 metres. The robots are to detect:
 - 1) disease-prone apple trees,
 - 2) apple trees already infected with powdery mildew and scab,
 - 3) determine how many trees are healthy,
 - 4) immediately commence precision spraying - eliminate the hazard.
3. Disease-prone apple trees are symbolised by brown circles (RGB 147, 107, 76) embedded in a white one-metre square banner with composite poles two-metre high and stuck in the middle. The number of such trees is unknown.

Ten apple trees were infested with the pathogens of scab and powdery mildew in proportions unknown to participants. Those infested with scab are gold (RGB 212, 159, 65) and those infested with powdery mildew are beige circles (RGB 249, 246, 227). The others are healthy trees, i.e. a square white banner with one-metre-long sides is spread under the poles.

Drones fly into the competition field prepared in this manner, or a mobile robot arrives. The flying and mobile robots search for trees on the verge of disease (brown circles) and infected trees (gold and beige coloured circles). Here, the teams can adopt two strategies: the scout robot starts spraying immediately or calls a specialised robot for help. However, the algorithm must be configured so that scab is treated with agent A and mildew with agent B. If the participant uses a mobile robot, it is allowed to move between the figures and must not enter any of them.
4. The plant protection chemicals are symbolised by gelatine paintballs, 0.68 inches in diameter, weighing 3.2 grams, in yellow and orange, and filled with biodegradable paints from any manufacturer. 10 balls of both colours are to be taken aboard the robot. The drones are supposed to throw them from about 4-6 metres using a gravity or pneumatic mechanism. As soon as apple scab is identified, yellow balls are flown. As soon as powdery mildew is detected, orange ones are thrown. The robots, on the other hand, can drive up to the edge of the figure to distribute the plant protection chemical.
5. The task is performed automatically. If conditions force the operators to take command during the task, they report this immediately to the jury. This means the end of the task. For airframes, manual take-offs and landings are allowed.
6. If a drone is involved, it must:
 - 1) be equipped with devices or systems installed on board it or being its ground equipment to facilitate:
 - a) keeping the assumed flight parameters,
 - b) ongoing monitoring of flight parameters, including determination of flight path, airspeed, flight altitude by barometric altimeter, degree of charge of power accumulators or fuel consumption, quality and strength of the communication signal between the unmanned aircraft and the remote-control station,

- c) basic location - determination of the current position, speed, altitude, and direction of the unmanned aircraft in order to transmit this data to the air traffic service provider via the telematics system or by telephone when requested by the ATS unit,
- d) emergency location - the determination by the operator of the current position of an unmanned aircraft in the event of an irreversible loss of control of that aircraft or the occurrence of a communication gap between the unmanned aircraft remote control station and that aircraft,
- e) automatic execution of the emergency procedure, including:
 - termination of the flight by an emergency landing, or
 - arrival at pre-programmed destination,
- 2) record the flight parameters from the moment the unmanned aircraft control system is activated until the moment the control system is deactivated.
7. If the system includes any mobile robot, it must provide:
 - 1) ongoing monitoring of driving parameters,
 - 2) emergency stop on the operator's command.
8. The team reports online the progress of tree detection and ball drop. Note: Using the gravity drop ensures that the balls are smashed about 6/10 of the time while using the pneumatic mechanism has an effect almost 100% of the time. Breaking up the balls is not necessary and is not subject to scoring, but it undoubtedly greatly facilitates and speeds up the counting of points and the effectiveness of the mission. The judges have the task of determining whether the correct ball has hit the area occupied by the pathogen.
9. The teams report remotely on the progress of the mission in real time, sending regular updates on the location, speed, and status of the robot. Key events are also reported, detection of trees on the verge of disease, location and identification of the pathogen, initiation of eradication with identification of the selected agent. The result of the mapping, i.e. a map of the orchard indicating the circles occupied by the pathogens and on the verge of the disease, should also be transmitted remotely and without delay, during the execution of the mission.
10. The robots have 20 minutes from the launch permit to conduct missions in the orchard. Disease-prone apple trees must be identified, and outbreaks of scab and powdery mildew must be detected, followed by the application of plant protection products.

100 composite poles measuring 2 metres in height and 12 mm in diameter are placed on the competition field. Beneath them, 10 circles in gold and beige and a publicly unknown number of circles in brown inscribed in square white banners of one-metre sides are spread out. The remaining poles are marked with one-metre square white banners - these are healthy trees. The golden circles symbolise apple scab, while the beige circles represent apple mildew. These circles were printed on 3-mm foamed PVC. Disease-prone apple trees, on the other hand, are represented by brown circles inscribed in a square of white banner.

The ball must fall within the circle. The task is successful if the ball hits the circle but jumps out unexpectedly by at most 30 cm. Generally, the ball should crash, and the paint will then spill. The Jury is obliged to check where the ball has fallen. If a ball of the wrong colour falls on an infected or disease-prone tree, no points are awarded. If it falls on a healthy tree, penalty points are awarded. The team reports progress in real time online.

The key technology is an algorithm that interprets the image (healthy tree, susceptible tree, tree infected with scab or powdery mildew), combined with a mechanism that triggers the right plant protection chemical at the right dose and applied correctly - one suitable ball falling on the infected tree.
11. Scores:

<p>For the preparation of a map of the orchards with the trees marked on it, broken down into those susceptible to disease and those infected by pathogens (with their discrimination), and a message on the state of the orchard</p>	<p>0 – 5</p>	<p>5 points = Ready-made digital map available online as part of the mission report with all trees broken down into disease-prone, scab-infested, mildew-infested, and healthy. Clear message as to how many trees there are of each type. 3 points = as soon as the trees with brown, beige, and gold circles were marked and a message was given as to how many there were. 1 point = map of only 10 trees occupied by pathogens with a message about the distribution of diseases. 0 points = no map. This is generally a 2D image - a top view of the competition area.</p>
<p>For accurately dropping the right ball (plant protection chemical) on an infected apple tree</p>	<p>0 – 10</p>	<p>1 point for an accurate throw of the correct ball within the gold (scab) or beige circle (powdery mildew). A point can be scored when the colour of the ball symbolising the plant protection chemical controlling the pathogen corresponds to the infestation detected. Yellow ball = scab; orange ball = powdery mildew.</p>
<p>For clearly photographing each outbreak (10 trees) and sending it immediately to the command post in the form of a communicative and clear mission report available online</p>	<p>0 – 5</p>	<p>Each pathogen detected = 0.5 points. The images are to be immediately available to the jury in the form of a report, e.g. on a website. It can be linked to a digital map. Each outbreak must be clearly marked.</p>
<p>Bonus for selected pathogen detection and eradication strategy</p>	<p>1 – 10</p>	<p>10 points = a successful “detect-react” action, whether using one robot or a team of two or more robots, as long as six or more of the correct balls were applied to the “sick apple trees”. 5 points = if the algorithm worked correctly but between five and nine balls fell outside the apple tree perimeter. 1 point = if the algorithm worked correctly, but only one or no balls hit the area occupied by the sick apple tree.</p>
<p>For a comprehensive online mission report</p>	<p>0 – 5</p>	<p>5 points - when there is an online map with a full breakdown of the trees, stating which ball was used, where, and at what time, a graphical representation of the trajectory of the drone flight and the time taken to complete the task. 3 points - when only there is information on which ball was used, where, and at what time, the drone’s flight path and the time of task completion are graphically presented. 1 point - when only times and locations of ball use are presented. 0 - when there is no online report.</p>

Dumping mechanism	0 – 5	5 points: a working mechanism that gives energy to the ball. 3 points = working gravitational mechanism. 0 points = mechanism not working.
Start and end of a job in automatic mode	0 – 2	One point for take-off, a second one for return. The robot must return fully to the area from which it started the task in automatic mode.
Bonus for mission in automatic mode	3	The bonus is added to the final score as long as the team completes the mission from start to finish in automatic mode.
The shortest-lasting mission of all the teams	5	Provided the mission has been completed by finding the correct trees and dropping the balls in under 20 minutes. If not, points are not accrued, and the mission is aborted. Points are accrued based on the other criteria.
For the second time	3	as above
For the third time	2	as above
For the fourth time	1	as above
For “spraying” a healthy tree or an incorrectly selected product in relation to the pathogen	– 0.5	Penalty points are deducted from the competition score for dropping a ball on a healthy tree (no circle). A maximum of 10 points can be lost from this as there are 20 balls on board.
Bypassing the launch site / completing the mission before the launch site	–2	Deducted from the competition score. The idea is to complete the missions on the take-off field.
For lack of logs	–5	According to the Regulations, the team has up to 30 minutes to submit the logs to the Technical Judge after the mission. IMPORTANT: returning to the starting point does not end the mission! The team leader must tell the judges that he/she considers the mission completed. Only then can they stop the clock, provided the mission lasts no longer than 20 minutes.
Maximum score	50	Penalty points, 17 in total, are deducted from this result including bonuses.



APPLICATION TO THE SZIR-RP2 COMPETITION

DATA

1. Data of head of team:
(name and surname, faculty at WUT, year and semester of study, type of programme: first- or second-cycle degree, contact details: e-mail, telephone)
2. Team members - list of implementers by name:
(name and surname, faculty at WUT, year and semester of study, type of programme: first- or second-cycle degree)
3. Data of mentor:
(name and surname, title/degree, faculty at WUT, institute/chair/division, (PhD student) contact details: e-mail, telephone)

By submitting this application, you agree that if a prize is awarded, the names of the team members and their mentor, as well as the name of the competition entry, will be made public in the information about the competition and results.