Physics Unbound 1.0

Robotics Challenge 2026

Organized by the Department of Physics, Faculty of Applied Sciences

Competition Theme

Autonomous Grid Navigation Challenge

The Autonomous Grid Navigation Robotics Competition is designed to challenge participants in the fields of robotics, embedded systems, autonomous navigation, and real-time decision making.

Teams are required to design and build a fully autonomous robot capable of navigating a grid-based arena by following lines and interpreting color-based commands using non-camera sensors.

The robot must:

1. Travel from the designated Start Point to the designated End Point.
2. Determine and execute the shortest valid route.
3. Return to the Start Point using the shortest possible path.

The competition emphasizes:

- autonomous navigation,
- efficient path planning,
- line following,
- sensor integration,
- embedded programming,
- and robotic system optimization.

Competition Guideline

1. Eligibility

- Open to students of the Faculty of Applied Sciences.
- Participants must compete in groups.
- A team can contain a minimum of one (1) member and a maximum of five (5) members.

- A participant can represent only one team.
- Each team must use its own robot.
- All participants must possess valid university/student identification documents and present them if requested by the organizing committee.

2. Robot Requirements

2.1 Robot Platform

- The robot chassis/platform must be **fully custom-made by the students**.
- The robot must operate fully autonomously.
- Commercial ready-made robot car kits or chassis are **not allowed**.
- Manual control is strictly prohibited during the run.

2.2 Maximum Dimensions

- Maximum base size: **5 inches × 5 inches**
- Height: **No limitation**

2.3 Power Supply

- Maximum allowed battery voltage: **24 V**

2.4 Allowed Controller Platforms

Only the following controller platforms are permitted:

- Standard Arduino boards
- ESP32 development boards

The following platforms are not allowed:

- Raspberry Pi
- Jetson boards
- FPGA boards
- External computing platforms

2.5 Allowed Sensors and Restrictions

Allowed Sensors

The robot may use:

- DC motors / servo motors / geared motors

- IR (infrared) sensor modules
- Reflective line-following sensors
- RGB color sensors
- Ultrasonic sensors
- Encoders
- IMU sensors

The following color sensors are specifically allowed:

- TCS34725/ TCS3200 RGB color recognition sensor
- Similar RGB color recognition sensors

Prohibited Components

The following components are strictly prohibited:

- Cameras or camera modules
- Computer vision-based systems
- Image-processing systems
- External computers for processing
- Wireless remote control during operation

Only onboard sensing and autonomous processing are permitted during the competition.

2.6 Autonomous Operation

- The robot must operate fully autonomously throughout the competition.
- Any form of wireless remote control or external intervention during operation is prohibited and will result in disqualification.

2.7Starting Procedure

- The robot starting procedure must not include any manual push, impulse, or external force in any direction.
- A physical onboard switch or button must be included to start the robot.

2.8 Lighting Conditions

- Robots must operate under the lighting conditions provided at the competition venue.
- Special lighting conditions or controlled illumination will not be guaranteed by the

organizers.

2.9 Arena Protection

- Robots must not damage the arena surface or surrounding equipment.

- Any robot considered unsafe or capable of damaging the arena may be disqualified before or during the competition.

3 Competition Structure

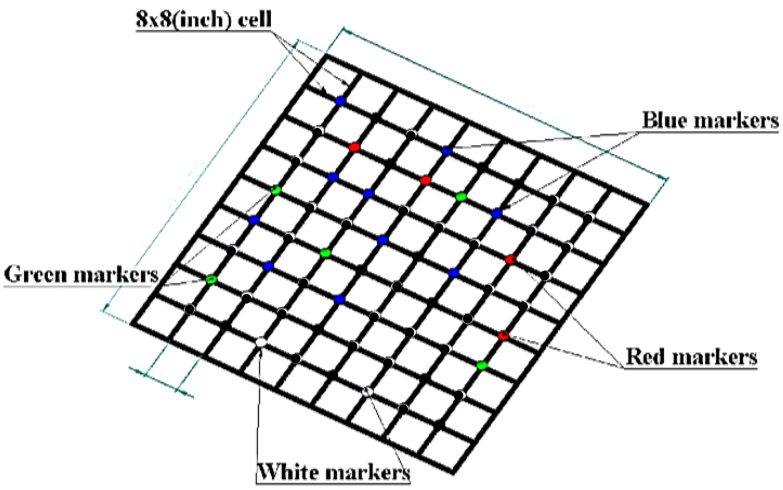
The competition consists of **two phases**.

3.1 Phase 1 — Path Navigation

The robot must autonomously navigate a predefined grid path from the starting point to the destination.

Arena Specifications

- Grid size: **8 inches × 8 inches**
- Path width: **1 inch**
- Arena background color: **White**
- Path color: **Black**



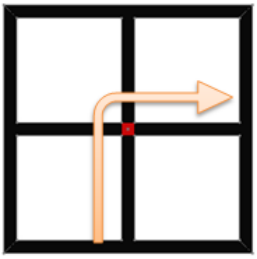
Junction Decision Rules

At specific junctions, color indicators will determine the robot's movement direction:

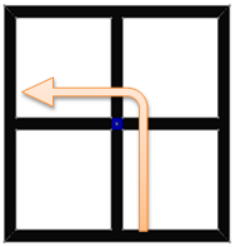
Color	Action
Black	Straight Forward
Blue	Turn Left
Red	Turn Right
Green	End Point
White	Start Point

The robot must detect the junction color and execute the corresponding movement autonomously based on:

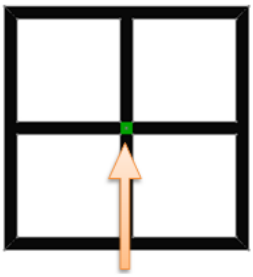
- line tracking,
- intersection detection,
- and color command interpretation.



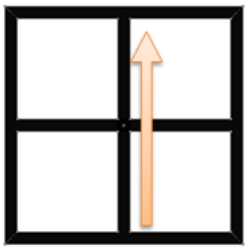
Turn Right



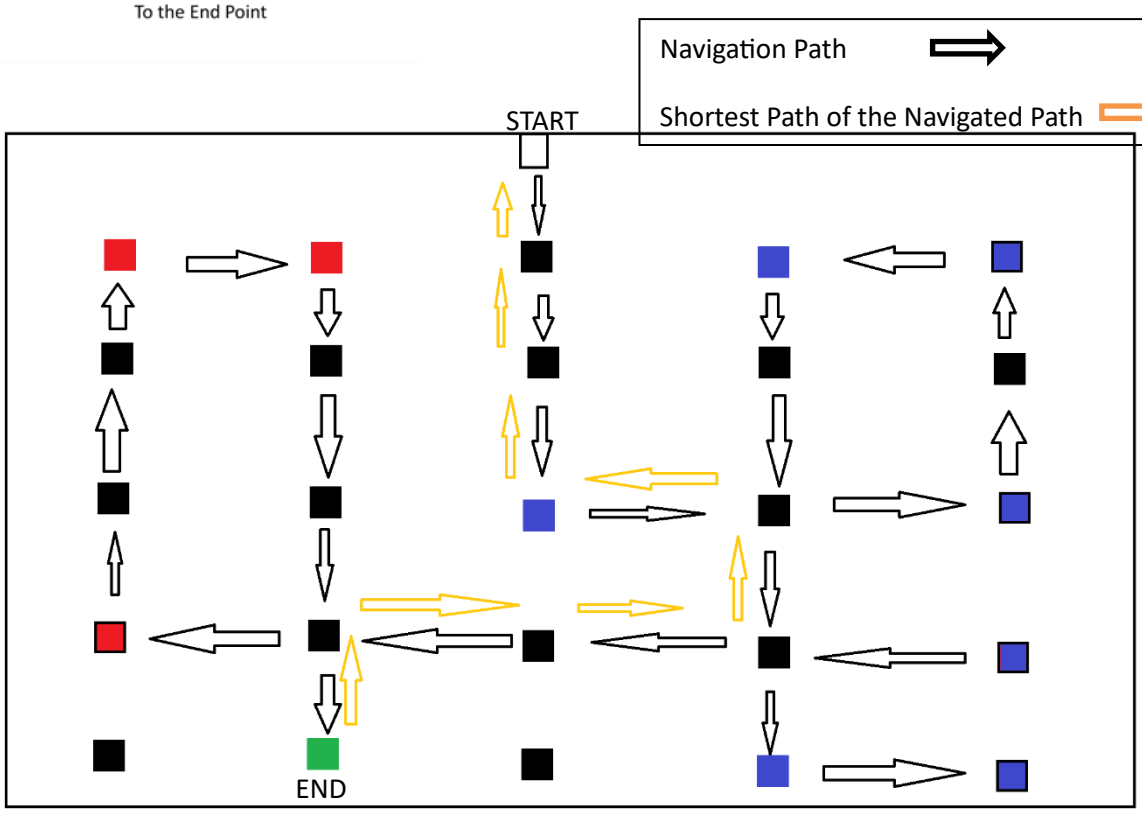
Turn Left



To the End Point



Straight Forward



3.2 Phase 2 — Shortest Path Return Challenge

After completing Phase 1, the robot must:

- Return to the original starting point
- Continue following the grid path autonomously
- Complete the task using the shortest possible valid path of the Navigated path (Phase 1) in the minimum possible time. There is no need to follow the color commands when returning to the Starting point.

  During Phase 2, multiple valid return paths may exist.
  The robot is expected to identify and follow the shortest valid path to the starting point.

3.3 Competition Procedure

1. Teams place the robot at the assigned Start Point.
2. Judges announce:
   - Start Point
   - End Point
3. Teams may calibrate sensors before the run.
4. Once the run starts:
   - No physical interaction is allowed.
5. Timing begins when the robot starts moving.
6. Timing stops when the robot successfully returns to the Start Point.

3.4 Competition Rules

Maximum Time Limit

- The maximum time allowed for a single attempt is five (5) minutes, including

initialization and calibration immediately before the run.

Leaving the Path

- If the robot completely leaves the designated path or arena during an attempt, the attempt will be immediately terminated.
- Teams may continue using their remaining attempts.

Arena and Path Information

- A partial example of the arena path layout, including sample junctions will be provided in the flyer and competition announcement.
- The complete final competition path will not be disclosed before the competition.

4 Arena Calibration and Attempts

4.1Arena Calibration

- The competition arena/platform will be provided to all participating groups before the competition begins for testing and fine-tuning purposes.
- Teams may calibrate and adjust their robots during the allocated preparation period only.

4.2 Attempts

- Each group will be given a maximum of **three (3) attempts within 15 minutes**.
- The best performance among the three attempts will be considered for final evaluation and ranking.

5 Scoring Criteria

5.1 Primary Scoring

The winner will be determined based on:

- Successful completion of the correct path(s),
- Accuracy of junction detection,
- Stability of navigation,
- Successful completion of the shortest return path(s),
- Minimum completion time.
- Mechanical and electronic design quality

5.2 Penalties

Violation	**Penalty**
Leaving the line	Time penalty
Incorrect turn	Time penalty
Collision with arena boundary	Time penalty
Manual intervention	Disqualification for the run
Failure to return to Start Point	Incomplete run

5.3 Tie-Breaking Rules

In case of a tie:

1. Robot with faster completion time wins.
2. If still tied:
    - Robots with fewer penalties win.

6. Safety Rules

- Robots must not damage the arena.
- Dangerous mechanisms are prohibited.
- Sharp edges and exposed hazardous wiring are not allowed.
- Teams are responsible for safe battery handling.

7. Judging Authority

The judges' decisions will be final regarding:

- rule interpretation,
- scoring,
- penalties,
- and technical compliance.

8. Recommended Technical Approaches

Participants are encouraged to implement:

- PID line following,
- graph traversal algorithms,
- shortest path algorithms,
- sensor fusion techniques,
- autonomous state machines.

Commonly used sensors may include:

- IR sensor arrays
- RGB color sensors such as:

- TCS34725 RGB Color Sensor
- TCS3200 Color Sensor

9. Additional Notes

- Lighting conditions will be standardized as much as possible.
- Teams are advised to calibrate sensors before each run.
- Arena layout may vary between rounds.
- The organizing committee reserves the right to inspect robots before the competition.
- Further competition details and schedules will be announced later.
- The judges' and organizing committee's decisions will be final in all matters related to the competition.

10.Awards and Recognition

- Valuable certificates will be awarded to all teams that successfully complete at least Phase 1.
- A valuable cash award will be presented to the overall winner.
- The overall winner will be determined based on the shortest total time taken to successfully complete both phases in a single attempt. (The fastest team in one individual phase may not necessarily be the fastest team overall.)

11. Event Information

🗓️ Competition Date: **16 July 2026**

📝 Registration Deadline: **10 June 2026**

🔗 Registration Link: https://docs.google.com/forms/d/e/1FAIpQLSdsRoKRpeZuE77CGSMNwQfoNLZwg0FOe7B_UpNVyAyzXxnJ8w/viewform?usp=publish-editor

📍 Venue: Department of Physics, Faculty of Applied Sciences

Coordinators

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