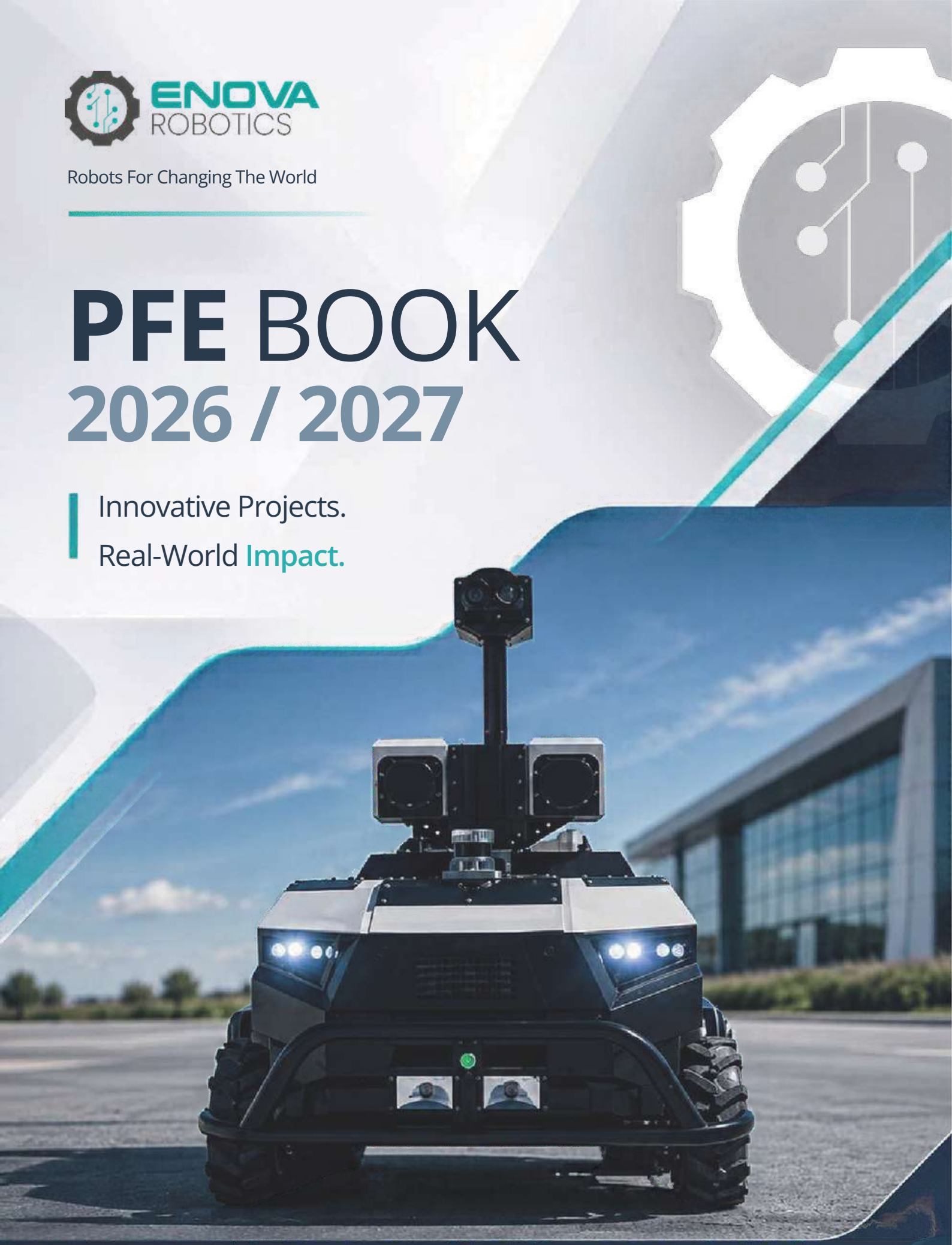
ENOVA ROBOTICS

Robots For Changing The World

PFE BOOK
2026 / 2027

Innovative Projects.
Real-World Impact.



Novation city, technopole de Sousse

www.enovarobotics.eu

ENOVA ROBOTICS

Summary

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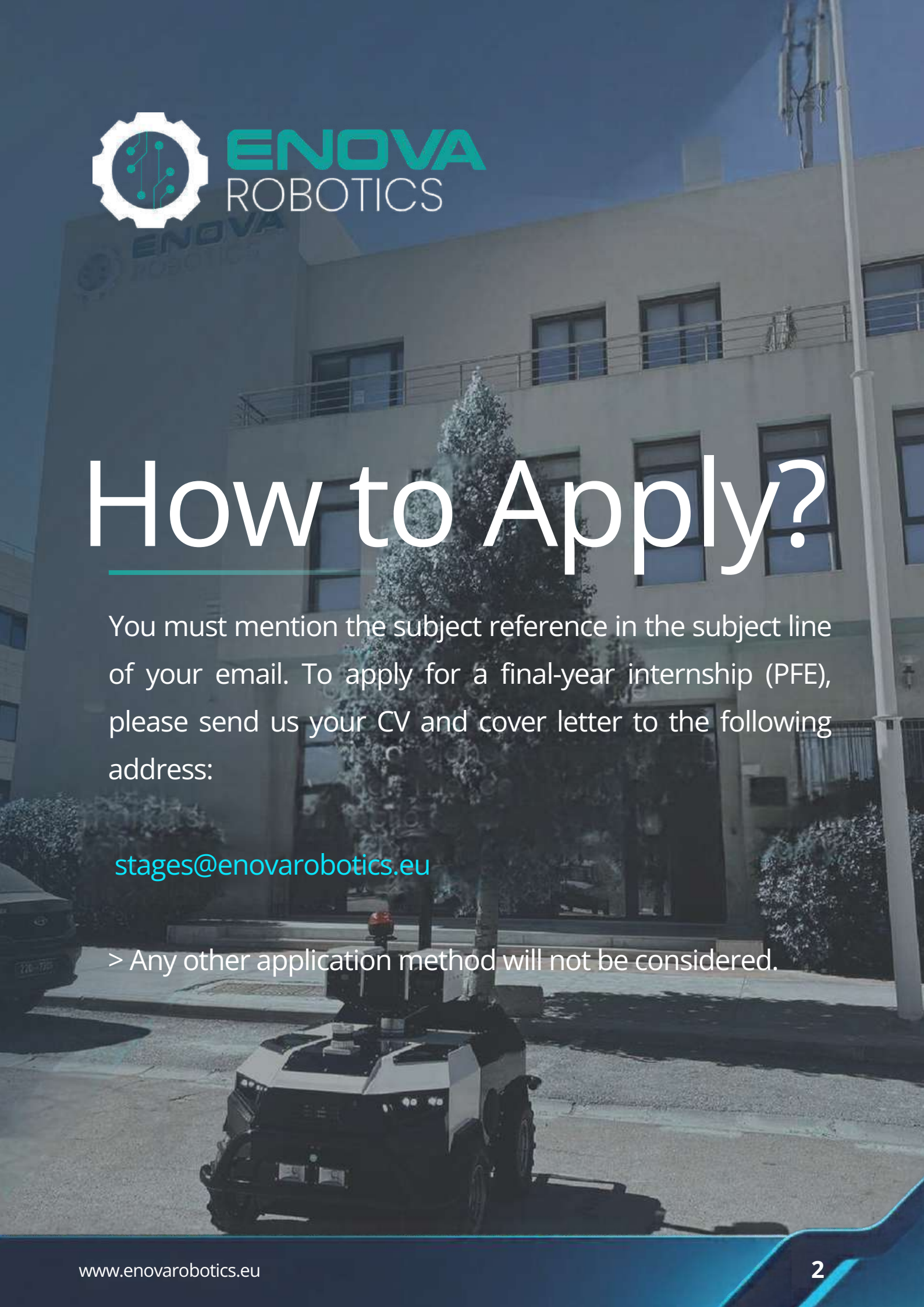
ENOVA ROBOTICS

ABOUT US

ENOVA ROBOTICS is an innovative company, founded in May 2014, specializing in the development, production, and commercialization of autonomous mobile robots.

ENOVA ROBOTICS is a pioneer in this field in Africa and the Arab world. The company develops and markets its own mobile solutions that meet needs in various sectors such as R&D, healthcare, security, surveillance, and marketing.





How to Apply?

You must mention the subject reference in the subject line of your email. To apply for a final-year internship (PFE), please send us your CV and cover letter to the following address:

stages@enovarobotics.eu

> Any other application method will not be considered.

ENOVA ROBOTICS

List of Topics

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Production 34

DESIGN

Reference : DESIGN001

TOPIC 01: Thermal Management Optimization for Autonomous Mobile Robots Through Product Design



1. Context and Objective

As Enova Robotics develops and commercializes autonomous mobile robots for Gulf countries, high temperatures pose a challenge to the proper operation of electronic components and onboard systems. This project explores how product design can improve robot thermal management through morphology, internal architecture, material selection, colors, and surface finishes.

2. Main Tasks

- Analyze the robot's architecture and thermal constraints.
- Study the influence of form on airflow and heat dissipation.
- Explore internal layout solutions and ventilation integration.
- Research materials, colors, and coatings suited to hot environments.
- Develop several design concepts and refine the selected solution.
- Create a 3D model of the proposed concept.

DESIGN

Reference : DESIGN001

3. Expected Deliverables

- Documentary research and benchmarking.
- Sketches and conceptual proposals.
- Comparative study of the proposed solutions.
- 3D model of the final concept.
- Realistic renders and project presentation.
- Thermal improvement proposals to be reviewed with the technical team.

4. Required Skills

- Industrial design and product design.
- Creativity and form development.
- Knowledge of materials.
- 3D modeling and product visualization.

5. Tools

3ds Max, KeyShot, Adobe Photoshop, and Illustrator.

Candidate Profile: Master's degree level (Bac+5) – students enrolled in a professional Master's program specializing in Product Design.

TOPIC 02: Functional and Systems Design of an Autonomous Surface Vehicle (USV) for Maritime Surveillance and Monitoring



1. Context and Objective

Autonomous surface vehicles (USVs) are increasingly used for maritime surveillance, reconnaissance, and monitoring missions. This project involves designing a USV using a functional and systems-design approach, focusing on its overall architecture, the integration of technological equipment, and adaptation to the constraints of the marine environment.

2. Main Tasks

- Benchmark existing autonomous surface vehicles.
- Study functional requirements and constraints related to the marine environment.
- Define the product's overall architecture and the layout of its internal volumes.
- Design the integration of sensors, cameras, antennas, and electronic systems.
- Explore modular solutions that facilitate product upgrades and maintenance.
- Study equipment protection and integration solutions for marine conditions.

DESIGN

Reference : DESIGN002

Develop the external form in line with the functional architecture.

Create a complete 3D model of the selected concept.

3. Expected Deliverables

- Documentary research and benchmarking.
- Functional architecture diagrams and component layout.
- Sketches and conceptual proposals.
- Complete 3D model of the USV.
- Exploded views and presentation of equipment integration.
- Realistic renders and presentation of the final concept.

4. Required Skills

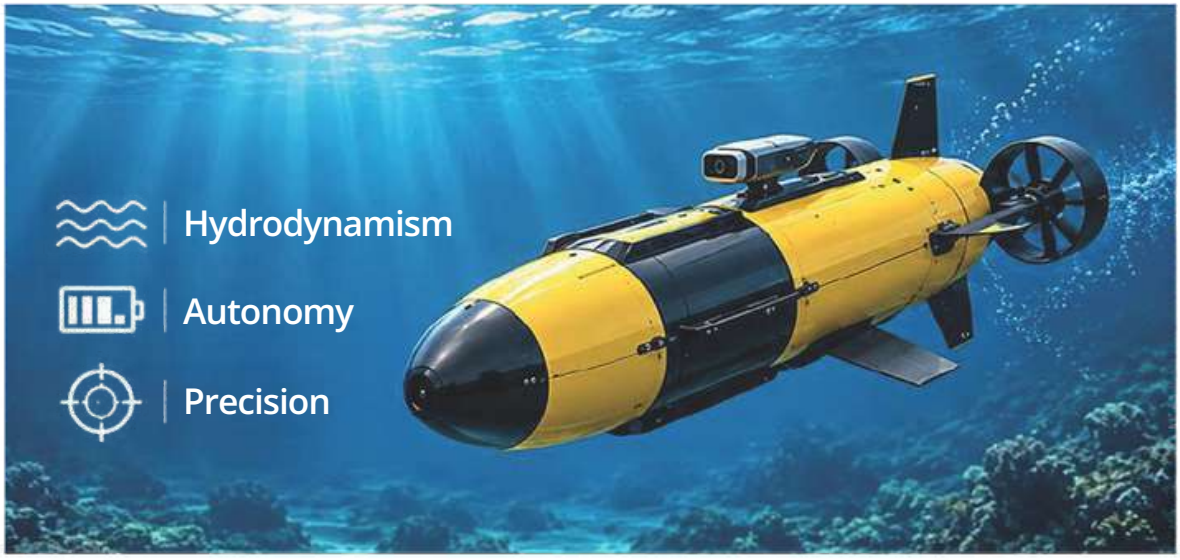
- Industrial design and functional design.
- Systems design and product architecture.
- Functional integration of components.
- Basic knowledge of materials and environmental constraints.
- 3D modeling and technical representation.

5. Tools

3ds Max, KeyShot, Adobe Photoshop, and Illustrator; basic knowledge of CAD and technical drawing.

Candidate Profile: Master's degree level (Bac+5) – students enrolled in a professional Master's program specializing in Product Design.

TOPIC 03: Hydrodynamic Design and Optimization of an Autonomous Underwater Vehicle (AUV) Hull



1. Context and Objective

Autonomous underwater vehicles (AUVs) are used for underwater exploration, inspection, and surveillance missions. Their design must address specific constraints related to water resistance, stability, maneuverability, and energy autonomy. This project explores the role of product design in improving AUV performance, with a focus on hull design and geometry to promote water flow and reduce hydrodynamic drag. It also aims to develop a functional architecture that accommodates propulsion systems, batteries, sensors, and electronic equipment.

2. Main Tasks

- Benchmark existing autonomous underwater vehicles.
- Study hydrodynamic principles applied to hull design.
- Explore different geometries and shapes that promote water flow.
- Study the influence of shape on hydrodynamic drag, stability, and maneuverability.

DESIGN

Reference : DESIGN003

- Define the overall architecture and internal component layout.
- Integrate propulsion systems, batteries, sensors, and navigation equipment.
- Study materials and sealing solutions suited to the underwater environment.
- Develop and create a 3D model of the final concept.

3. Expected Deliverables

- Documentary research and benchmarking.
- Comparative study of hull shapes.
- Sketches and conceptual proposals.
- Detailed 3D model of the AUV.
- Exploded views and equipment integration.
- Realistic renders and presentation of the final concept.
- Evaluation of design choices with the technical team.

4. Required Skills

- Industrial design and form development.
- Functional design and product architecture.
- Basic knowledge of hydrodynamics and materials.
- 3D modeling and technical representation.

5. Tools

3ds Max, KeyShot, Adobe Photoshop, and Illustrator.

Candidate Profile: Master's degree level (Bac+5) – students enrolled in a professional Master's program specializing in Product Design.

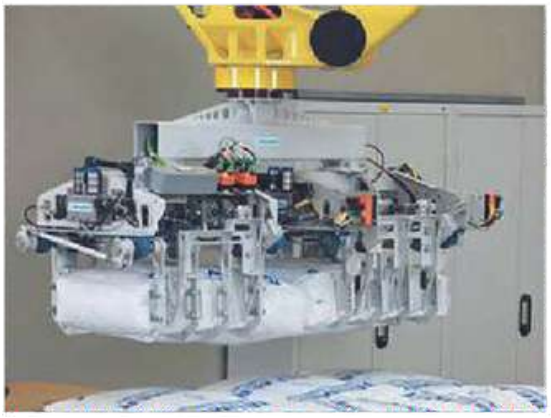
MECHATRONICS

Reference : MECHA001

TOPIC 01: Design, Sizing and Validation of a Heavy-Duty Robotic Gripper or Industrial Palletizing Applications



Concept illustration – heavy-duty adjustable gripper



Concept illustration – robotic palletizing application

1. Context and Objective

Industrial palletizing operations often require the handling of large and heavy products with different dimensions and packaging characteristics. The reliability of the gripping tool is essential to ensure safe handling, repeatable cycles and effective integration with industrial robots. This project aims to develop a robust, lightweight and adaptable end-of-arm tooling solution designed to handle products weighing up to 50 kg.

The main objective is to design, size and validate a robotic gripper for heavy-duty palletizing and depalletizing applications. The gripper shall accommodate a defined range of product sizes, provide reliable retention during robot motion, and remain compatible with the payload and wrist load limits of the selected industrial robot.

2. Main Tasks

Functional analysis and specification: Study industrial gripping principles; identify target product families, dimensions, mass range, contact surfaces and operating constraints; establish the functional and technical specifications.

Mechanical design and 3D modelling: Develop the gripper architecture and detailed 3D models in SolidWorks; design the gripping mechanism, adjustable elements, structural frame and robot-mounting interface...

Material and component selection: Select suitable materials and standard components based on strength, stiffness, mass, manufacturability, availability and cost.

Mechanical sizing and strength calculations: Calculate gripping forces, structural loads, load paths, stresses and deflections. Account for the product mass, gripper mass, centre of gravity and relevant safety factors.

Finite Element Analysis (FEA): Perform SolidWorks Simulation studies for relevant load cases; assess stress distribution, deformation and safety margins; optimize geometry and material choices based on simulation results.

Bill of Materials and technical documentation: Prepare the Bill of Materials (BOM), detailed drawings, assembly drawings, manufacturing information, component references and a technical dossier. Include a cost estimation.

3. Expected Deliverables

- Functional analysis and approved technical specification
- Complete SolidWorks 3D assembly and native CAD files
- FEA simulation report with identified load cases and results
- Bill of Materials (BOM) and component list
- Technical manufacturing and assembly dossier

4. Recommended Candidate Profile

- Mechanical, Mechatronics, or Electromechanical Engineering student, autonomous and proactive, with a strong interest in mechanical design, dimensioning, and industrial robotics.
- Good knowledge of SolidWorks and technical drawings, with familiarity with Finite Element Analysis (FEA) tools such as SolidWorks Simulation, Abaqus, or ANSYS.

MECHATRONICS

Reference : MECHA002

TOPIC 02: Design and integration of an autonomous surface vehicle (USV) for surveillance



1. Context and Objective

Unmanned surface vehicles (USV) are increasingly used for surveillance and monitoring at sea. This project consists of designing the mechanical platform of an autonomous boat with a black sheet-metal hull, and integrating its detection systems, radio equipment and antennas.

2. Position

Mechanical engineer, electromechanical engineer or equivalent profile.

3. Main tasks

- 3D design of the USV and structure.
- Integration of detection sensors, radio equipment and antennas.
- Propulsion and power system selection.
- Simulation and validation of the design.

MECHATRONICS

Reference : MECHA002

4. Expected deliverables

- Complete 3D model and concept design of the boat.
- Technical drawings and bill of materials (BOM).
- Simulation report and final PFE report.

5. Skills and tools

Mechanical design, strength of materials, system integration. Tools: SolidWorks or CATIA, SolidWorks Simulation or ANSYS.

MECHATRONICS

Reference : MECHA003

TOPIC 03: Design and study of a 8-wheel robot with high payload capacity



1. Context and Objective

Mobile robots working on rough terrain need a strong and stable base that can carry heavy loads and host different equipment. This project consists of designing the platform and chassis of an 8-wheel robot with a rigid structure and a high payload capacity.

2. Position

Mechanical engineer, electromagnetic engineer or equivalent profile.

3. Main tasks

- Design of the rigid chassis and the flat mounting platform.
- Layout of the 8 wheels with suspension .
- Motor, transmission and wheel sizing for a high payload.
- Design of mounting interfaces for sensors, antennas, batteries and other modules.
- Structural simulation and optimization of the chassis.

4. Expected deliverables

- Complete 3D model of the platform and chassis.
- Calculation notes and structural simulation report.
- Technical drawings and bill of materials (BOM).
- Final PFE report.

5. Skills and tools

Mechanical design, strength of materials, kinematics, design for manufacturing.

Tools: SolidWorks, SolidWorks Simulation or ANSYS.

FULL STACK

Reference : FULLSTACK001

TOPIC 01: Design and Development of a Real-Time Monitoring and Supervision Platform for Autonomous Mobile Robots (AMRs)



1. Description

In industrial environments, autonomous mobile robots (AMRs) carry out missions independently and continuously transmit operational data. A centralized platform is needed to visualize their status and facilitate their operation.

2. Candidate Profile

Final-year engineering student specializing in Computer Science or Software Engineering.

3. Required Skills

Blazor / React, TypeScript, ASP.NET Core Web API.

FULL STACK

Reference : FULLSTACK002

TOPIC 02: Design and Development of a Control and Supervision Platform for a Collaborative Robotic Arm for Printed Circuit Board (PCB) Inspection



1. Description

As part of Industry 4.0, automating printed circuit board (PCB) inspection helps improve quality, traceability, and productivity. This project aims to design a web platform for controlling, configuring, and monitoring a collaborative robotic arm equipped with a vision system. The application will manage inspection programs, display the cobot's status and operation progress in real time, and provide access to PASS/FAIL results and detected defects. It will include serial number traceability, statistical dashboards, alerts, and report generation. Robotic arm commands will be sent through the robot controller's secure interfaces.

2. Candidate Profile

Final-year engineering student specializing in Computer Science or Software Engineering.

3. Required Skills

Blazor / React, TypeScript, C#, ASP.NET Core Web API, SQL Server.

Knowledge of REST APIs, Entity Framework Core, and Git is an advantage.

FULL STACK

Reference : FULLSTACK003

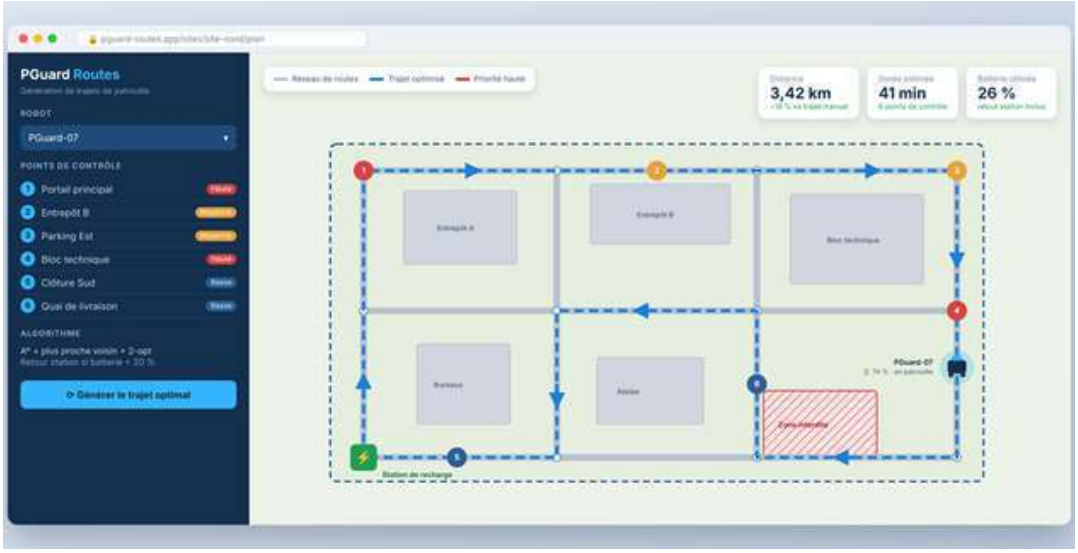
TOPIC 03: Design and Development of a Web Platform for Generating and Optimizing Patrol Routes for the PGuard Robot

1. Description

- For the operation of the PGuard autonomous security robot, Enova Robotics aims to develop a standalone web platform capable of automatically generating and optimizing patrol routes for a site. The project involves designing and developing the following features:
- Role management: administrators create user or administrator accounts and assign robots to users; each user is responsible for one or more assigned robots and manages only those robots.
- Administrator dashboard: monitor each user and their robots' activities (generated routes, completed patrols, distance, duration, and battery consumption).
- Site map design (Leaflet + OpenStreetMap): define patrol areas, navigable paths, restricted zones, and the charging station.
- Route network generation: convert drawn paths or OSM data into a graph (nodes and weighted edges).
- Checkpoint placement with priorities and visit frequencies.
- Optimal route generation covering all checkpoints and returning to the charging station: shortest path algorithms (Dijkstra / A*) and visit-order optimization (nearest neighbor + 2-opt).
- Constraint handling: battery range, restricted zones, and more frequent visits to high-priority checkpoints.
- Animated simulation of the robot following the route (distance, duration, battery) and robot status (idle, patrolling, charging).
- Route comparison, history, route export (GeoJSON/JSON), and PDF reports.
- Duration: 4 to 6 months.

FULL STACK

Reference : FULLSTACK003



2. Candidate Profile

Final-year Computer Science or Software Engineering student, self-motivated and inquisitive, with an interest in robotics and algorithms.

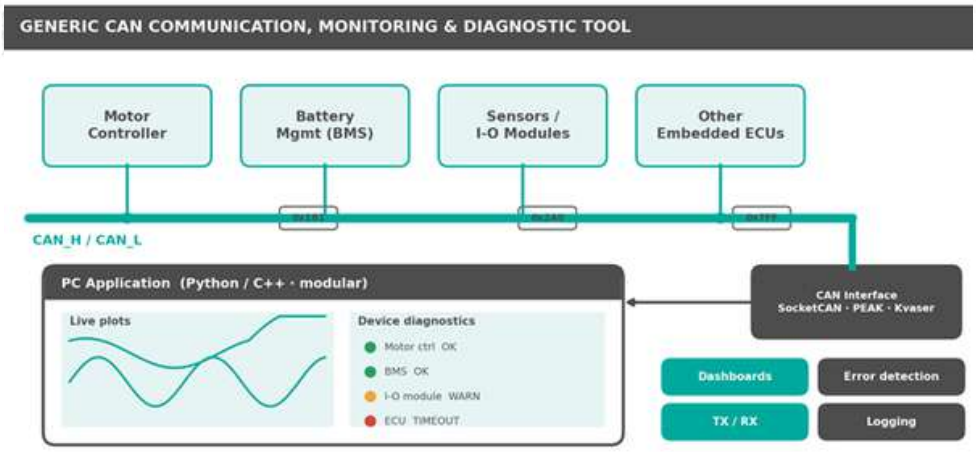
3. Required Skills

React, Node.js / Express, MongoDB, REST APIs, JWT authentication, Leaflet (mapping), solid fundamentals in algorithms (graphs, shortest paths), and Git. Docker is a plus.

NAVIGATION

Reference : NAVI001

TOPIC 01: Development of a Generic CAN Communication, Monitoring, and Diagnostic Tool



1. Description

CAN communication is widely used in mobile robotics to connect devices such as motor controllers, battery management systems (BMS), and other embedded components. This internship focuses on developing a modular PC application adaptable to different CAN interfaces and devices, providing a unified solution for communication, real-time monitoring, and system diagnostics.

2.Objective

Develop a configurable application supporting CAN message transmission and reception, real-time visualization, and data logging.

• Diagnostic layer: monitor individual device statuses, detect communication errors, and provide a system-wide overview.

• Interactive plots and configurable dashboards: analyze device parameters and identify abnormal behavior.

3. Required Skills

Proficiency in Python and C++.

Fundamental knowledge of CAN bus communication.

Experience in software development and modular architectures.

4.Recommeded Skills

- Familiarity with CAN interfaces, drivers, and communication APIs.
- Knowledge of CAN protocols and embedded systems.
- Experience in data visualization and real-time data analysis.
- Familiarity with graphical user interface development.

TOPIC 02: Adaptive Hybrid Navigation for Autonomous Mobile Robots in GPS-Denied Environments



1. Description

Autonomous mobile robots operating in outdoor environments often rely on GPS/GNSS for global localization and navigation. However, satellite signals can become unavailable or unreliable in certain environments, making continuous autonomous navigation challenging. This project focuses on developing a hybrid navigation system capable of operating with and without GPS availability. The system should automatically adapt to changes in signal availability by combining satellite-based positioning with onboard localization techniques, ensuring continuous navigation and reliable position estimation even when GPS signals are lost.

2.Objective

- The objective of this project is to develop an adaptive navigation system that enables a mobile robot to navigate seamlessly between GPS-assisted and GPS-denied operating modes. The approach will combine GPS/GNSS data with LiDAR, IMU, and camerabased localization techniques through sensor fusion. The system should detect GPS signal degradation or loss, automatically transition to an alternative localization strategy, and maintain accurate positioning and autonomous navigation until GPS availability is restored.

NAVIGATION

Reference : NAVI002

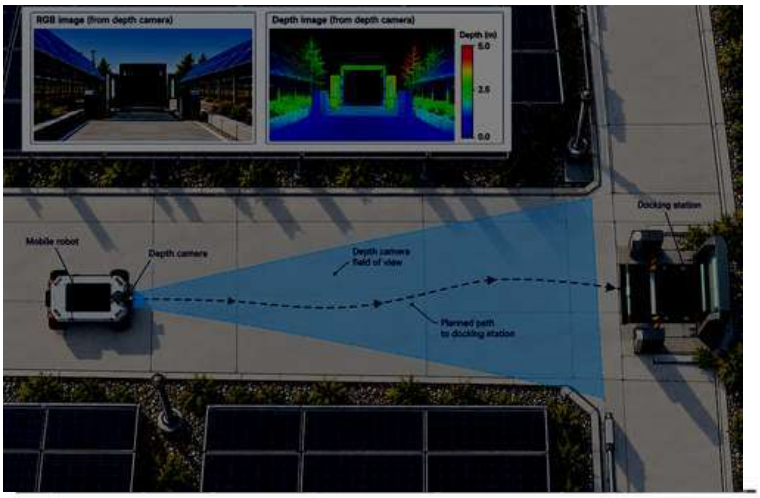
3. Required Skills

- Proficiency in Python and C++.
- Experience with ROS 2.
- Knowledge of autonomous navigation and localization.
- Understanding of sensor fusion and coordinate transformations.

4.Recommeded Skills

- Familiarity with GPS/GNSS, LiDAR, IMU, and camera-based perception.
- Knowledge of SLAM, visual odometry, and LiDAR odometry.
- Experience with Nav2 and localization algorithms.
- Understanding of Kalman Filters (EKF/UKF).
- Familiarity with Gazebo or other robotics simulation environments.

TOPIC 03: Autonomous Docking System for an Outdoor Mobile Robot



1. Description

Autonomous mobile robots operating in outdoor environments require reliable and precise docking capabilities to perform tasks such as battery charging, parking, and automated mission completion.

Unlike indoor environments, outdoor conditions introduce additional challenges, including variable lighting, uneven terrain, obstacles, and environmental disturbances that can affect perception and positioning accuracy.

This project aims to develop an autonomous docking solution using a depth camera, enabling an outdoor mobile robot to detect, localize, approach, and accurately align itself with a docking station without human intervention.

2.Required Skills

- Proficiency in C++ and/or Python.
- Good knowledge of ROS 2 and autonomous mobile robotics.
- Solid understanding of computer vision and image processing.
- Knowledge of robot navigation, localization, and control.
- Familiarity with depth cameras and 3D perception.
- Strong analytical and problem-solving skills.

TOPIC 04: Adaptive Terrain-Aware Navigation for Autonomous Mobile Robots in Uneven Outdoor Environments



1. Description

- Autonomous mobile robots operating in outdoor environments must navigate across uneven terrain, including hills, slopes, and irregular surfaces. Conventional navigation systems designed primarily for flat environments may incorrectly classify terrain variations as obstacles, limiting the robot's ability to navigate efficiently. This project focuses on developing a terrain-aware navigation system capable of analyzing environmental geometry, identifying slopes and elevation changes, and distinguishing traversable terrain from actual obstacles. Particular attention is given to downhill navigation, enabling the robot to recognize descending terrain as a navigable surface rather than automatically treating it as an obstacle.
- The objective of this project is to develop an adaptive outdoor navigation system that enables a mobile robot to perceive and understand non-flat environments. By combining 3D perception, terrain analysis, and adaptive path planning, the robot should evaluate terrain traversability, identify safe navigation regions, and adapt its trajectory according to surface inclination and elevation changes.

NAVIGATION

Reference : NAVI004

2. Required Skills

- Proficiency in Python and C++.
- Experience with ROS 2.
- Knowledge of autonomous navigation and motion planning.
- Understanding of robotics perception and coordinate transformations.

3. Recommended Skills

- Familiarity with LiDAR, RGB-D cameras, and point cloud processing.
- Knowledge of terrain mapping, elevation maps, and surface analysis.
- Experience with Nav2 and 3D perception.
- Understanding of sensor fusion and obstacle detection.
- Familiarity with Gazebo or other robotics simulation environments.

IT & CYBERSECURITY

Reference : IT001

TOPIC 01: Design and Implementation of a Centralized Cybersecurity Monitoring, Correlation, and Incident Detection Platform Based on an Open-Source SIEM Solution



1. Description

- As part of its efforts to strengthen the security of its information system, Enova Robotics is offering a final-year project focused on designing and deploying a centralized platform for cybersecurity monitoring and incident detection.
- The project involves studying the existing IT infrastructure, designing a SIEM architecture, and implementing a solution to centralize, analyze, and correlate security events from the company's various devices and systems.
- The intern will deploy and configure a solution based on open-source technologies such as Wazuh and OpenSearch, integrate network equipment (particularly FortiGate), Linux and Windows servers, develop custom detection rules, and implement dashboards and alerting mechanisms.
- The project will also include incident-simulation scenarios to test and validate the effectiveness of the deployed solution.

2.Candidate Profile

- Final-year engineering student (Bac+5).
- Specialization: Computer Networks, Systems, and Cybersecurity.
- A strong interest in cybersecurity, monitoring, and IT infrastructure administration.

3.Required Skills

- Good knowledge of computer networks (TCP/IP, DNS, DHCP, VLAN, VPN).
- Good command of Linux and Windows operating systems.
- Knowledge of server and network equipment administration.
- Basic knowledge of cybersecurity, intrusion detection, and system log analysis.
- Knowledge of Syslog and SNMP protocols.
- Basic Python or Bash scripting skills.
- Knowledge of SIEM solutions, particularly Wazuh, is an advantage.
- Internship duration: 4 to 6 months.

IT & CYBERSECURITY

Reference : IT002

TOPIC 02: Design and Development of a Secure and Resilient Long-Range Wireless Communication Architecture for Autonomous Mobile Robots



1. Description

- This project aims to investigate, design, and develop a wireless communication solution as an alternative to Wi-Fi and cellular networks (4G/5G), providing reliable and secure connectivity between autonomous mobile robots and their supervision station, particularly in remote or challenging environments.
- The proposed solution must support the simultaneous transmission of different types of data, including real-time video streams, robot telemetry, and remote control commands, while ensuring suitable performance in terms of communication range, bandwidth, latency, and availability.
- Particular attention will be given to communication security (encryption, authentication, and data integrity), as well as resilience mechanisms to maintain or restore connectivity in the event of communication disruptions or link failures.
- The project will result in an experimental prototype and a performance evaluation under different operating scenarios.

IT & CYBERSECURITY

Reference : IT002

2.Required Profile

- Final-year student specializing in Telecommunications, Computer Networks, Embedded Systems, or Cybersecurity.

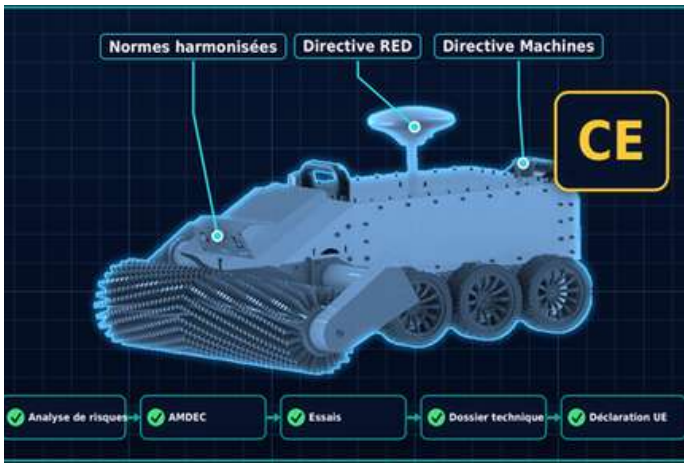
3.Required Skills

- Wireless communication technologies and RF fundamentals.
- Computer networking and TCP/IP, UDP protocols.
- Network security and cryptography.
- Embedded systems and Linux environment.
- Python and/or C/C++ programming.
- Video streaming protocols and real-time communication.
- Network performance analysis and troubleshooting.

PRODUCTION

Reference : PROD001

TOPIC 01: Implementation of the CE Marking Process for the P-SOLAR Autonomous Robot



1. Description

- Enova Robotics develops autonomous mobile robots intended for the European market. Placing these products on the market requires CE marking in compliance with the Machinery Directive, the Radio Equipment Directive (RED), and the relevant harmonised standards.
- The technical documentation involves numerous documents (risk assessments, FMEA, specifications, test reports, declarations, etc.), making consistency and traceability difficult to manage effectively.
- How can the CE marking process be structured and industrialised to ensure a complete, consistent, and traceable technical file, ready for assessment by a Notified Body and reusable for future robot developments?

2.Objective

- To define and implement a quality-driven CE marking process, from risk assessment to the EU Declaration of Conformity, ensuring effective document control and full traceability.

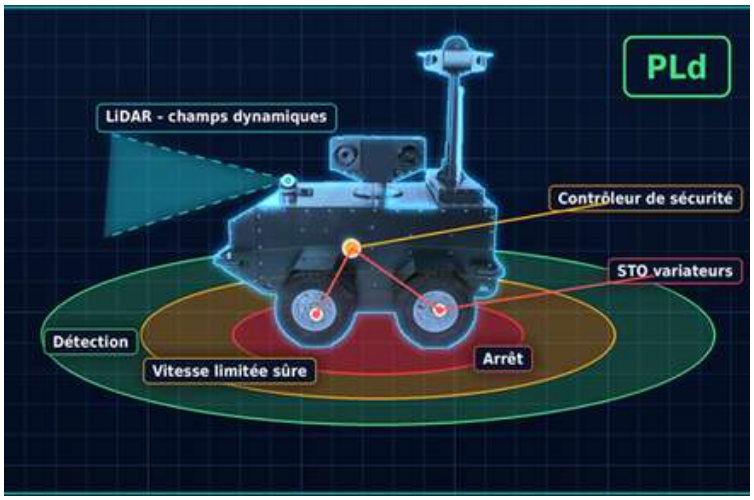
3.Relevant Skills

- Profile: Quality Engineer / Mechatronics Engineer
- Areas: Risk Analysis • FMEA • Document Management

PRODUCTION

Reference : PROD002

TOPIC 02: Design and Validation of a Mobile Robot's Safety Functions in Accordance with EN ISO 13849



1. Description

- Enova Robotics' mobile robots incorporate safety functions such as emergency stops, Safe Torque Off (STO) for motor drives, obstacle detection, and battery protection. The current architecture is designed for deployment in controlled-access environments. Expanding into public environments, where untrained individuals may be present, requires higher performance levels and additional safety functions.
- How can the robot's safety architecture be upgraded to achieve Performance Level PLd, by integrating Safe Limited Speed (SLS) and dynamic protective fields, while demonstrating compliance with EN ISO 13849-1/-2?

2.Objective

- To design, calculate, and validate an advanced PLd safety architecture (Safe Limited Speed, dynamic protective fields, and a dedicated safety controller) for an autonomous mobile robot operating in public environments.

3.Relevant Skills

Profile: Mechatronics Engineer / Quality Engineer

Areas: Functional Safety (EN ISO 13849-1/-2, EN ISO 13855) • SISTEMA

PRODUCTION

Reference : PROD003

TOPIC 03: Design of the Electrical Architecture of a Mobile Security Robot in Accordance with EN 60204-1



1. Description

- Enova Robotics' mobile robots are powered by a 52 V LiFeP04 battery, which distributes power to motor drives, converters, computing units, sensors, and communication systems. The design of the wiring, protection devices, and power distribution system must ensure electrical safety, reliability, and compliance with the EN 60204-1 standard.
- How can a robust, selective, and compliant 52 V electrical architecture be designed to protect each circuit, minimisese voltage drops and overheating, and facilitate maintenance and certification?

2.Objective

- To design and validate the robot's 52 V electrical power distribution architecture (wiring, protection devices, power conversion, and grounding) in compliance with EN 60204-1, including calculation reports and verification tests.

3.Relevant Skills

- Profile: Electrical Engineer / Mechatronics Engineer / Quality Engineer
- Areas: Electrical Safety (EN 60204-1)

PRODUCTION

Reference : PROD004

TOPIC 04: Development of an Intelligent System for Managing and Optimizing Raw Material and Robot Component Inventory



1. Description

- To improve inventory management at Enova Robotics, this project aims to develop a computerised tool to monitor incoming and outgoing stock movements, ensure component traceability, and automatically calculate material requirements based on the Bills of Materials (BOMs) of the various robots manufactured.

2.Objective

- To develop a computerised tool for tracking stock movements (inbound and outbound), ensuring component traceability, and automatically calculating material requirements based on robot Bills of Materials (BOMs).

2.Required Skills

- Background in Industrial IT, Industrial Engineering, Electromechanics, or Computer Science.
- Proficiency in Excel and database management.
- Programming skills.
- Basic knowledge of inventory management and procurement processes.
- Analytical mindset, attention to detail, and strong organisational skills.

TOPIC 05: Study and Improvement of a Mobile Robot's Design: Improving Maintenance and Component Accessibility



1. Description

- At Enova Robotics, field mobile robots incorporate numerous subsystems, including drive systems, batteries, control electronics, sensors, and vision systems. In the current design, the robot's compartments are difficult to access, resulting in longer maintenance and troubleshooting operations.
- How can the robot's mechanical architecture be redesigned to ensure that all maintenance points are quickly and safely accessible, without requiring extensive disassembly or compromising the overall protection and robustness of the system?

2.Objective

To modify the robot's design in order to make all maintenance points easily accessible, simplify maintenance operations, and reduce intervention time.

3.Proposed Tasks

- Audit: Analyse the current architecture and identify components requiring regular maintenance (batteries, electronics, connectors, motors, and sensors).
- Diagnosis: Identify hard-to-access compartments and obstacles encountered during maintenance operations.

- Design: Propose new solutions, such as removable covers and access panels, quick-release fasteners, component repositioning, and modular design.
- Modelling: Model the proposed modifications using 3D CAD software and verify clearances, structural rigidity, sealing, and integration.
- Validation: Prepare the technical documentation and a validation prototype or mock-up, including a before-and-after comparison.

4.Relevant Skills

- Mechanical Design and CAD (SolidWorks or equivalent) • Technical Drawing • Electromechanics • Maintenance Methods • Functional Analysis • Technical Documentation.

5.Expected Deliverables

- Technical study report.
- CAD models and technical drawings of the redesigned architecture.
- Simplified maintenance and access guide.
- Validation prototype or mock-up.

TOPIC 06: Preparation of an Electrical Wiring Procedure for a Mobile Security Robot



1. Description

- At Enova Robotics, mobile security robots integrate numerous electrical and electronic components, including drive systems, batteries, computing units, sensors, cameras, and lighting systems. The wiring of these robots must be reliable, safe, and consistent from one robot to another, supported by clear procedures for technicians.
- How can the robot's wiring architecture be structured (cable routing, separation of power and data cables, and cable cross-section sizing) and properly documented to ensure safety, electromagnetic compatibility, and ease of maintenance?

2.Objective

- To define and document a comprehensive, safe, and standards-compliant electrical wiring procedure, ensuring physical separation between power and data cables.

3.Proposed Tasks

- **Documentation:** Create illustrated documentation for technicians, including wiring steps, photographs, and identification labels.
- **Diagrams:** Produce the robot's complete electrical wiring diagram.
- **Identification:** Identify existing cables and their functions (power supply, control, signals, and communication).
- **Routing:** Design a new cable-routing layout, physically separating data and communication cables from electrical power cables to ensure safety and prevent electromagnetic interference.
- **Sizing:** Analyse and determine cable cross-sections according to the electrical characteristics of each component, ensuring compliance with applicable safety standards.

4.Relevant Skills

- Electrical Diagrams and Electrical CAD Software • Cable and Protection Device Sizing • Electromagnetic Compatibility (EMC) • Electrical Safety Standards • Wiring and Connectors • Technical Procedure Writing.

5.Expected Deliverables

- Illustrated electrical wiring procedure.
- Complete electrical wiring diagram.
- Cable identification and function table.
- Cable-routing layout.
- Cable cross-section sizing and calculation report.

Contact us

Novation City - Technopole de Sousse,
Sousse 4059, Tunisia
(+216) 73 823 023
Stages@enovarobotics.eu
www.enovarobotics.eu

