

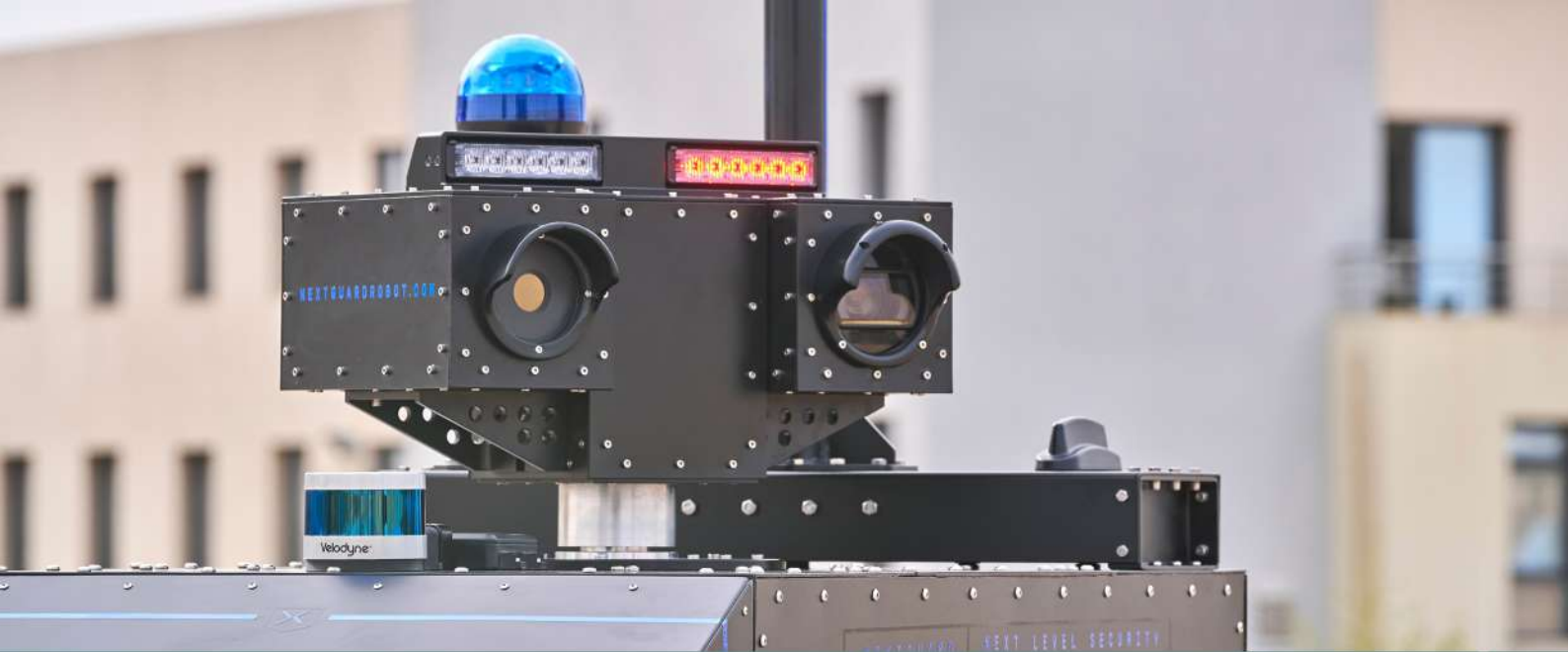
PFE BOOK

2025 / 2026



SUMMARY

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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.

List of topics

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MECHATRONICS

Reference: MECHA01

Subject 1 : Automation of the loading and unloading process of raw parts on a 5-Axis CNC machine

Description :

This end-of-studies project aims to design, model, and implement a robotic solution to automate the loading (mounting) and unloading (dismounting) of raw parts on a 5-axis CNC machine.

The main objective is to reduce downtime between machining operations, improve productivity, and minimize manual intervention, while ensuring operator safety and precise part positioning.

The project involves the study, sizing, and simulation of a complete automation system that integrates an industrial robot (or collaborative robot), a customized gripping system, and a communication interface with the CNC machine.

Required Skills:

- Mechanical design and 3D modeling (SolidWorks, CATIA).
- Industrial robotics (kinematics, trajectory planning, robot selection, simulation).
- Basic electrotechnics and pneumatics.
- Strong analytical and technical synthesis skills.
- Knowledge of industrial integration and manufacturing systems.



MECHATRONICS

Reference: MECHA02

Subject 2 : Design of a security robot casing Based on an existing industrial concept

Description :

This end-of-studies project aims to carry out the complete mechanical design of a security robot casing, based on an existing industrial design.

The goal is to transform an aesthetic concept (3D design or sketch) into a functional, manufacturable, and technically feasible mechanical solution, adapted to the robot's mechanical, electronic, and assembly constraints.

This project takes place in an industrial context where autonomous surveillance and security robots are increasingly deployed for access control, patrolling, and anomaly detection in sensitive areas such as factories, warehouses, and industrial zones.

Required Skills:

- Proficiency in CAD software such as SolidWorks, CATIA, Fusion 360, or Siemens NX.
- Ability to convert aesthetic designs into manufacturable industrial models.
- Plastics, composites, aluminum, and their forming processes (machining, molding, 3D printing).
- Adapting models for industrial production feasibility.
- Basic understanding of stress analysis and material strength.
- Understanding of sensor, battery, PCB, and motor placement within enclosures.



MECHATRONICS

Reference: MECHA03

Subject 3 : Study and Design of a Robotic Automation Line for Animal Feed Bag Packaging

Description :

This end-of-studies project aims to design a robotized solution to automate the packaging process of animal feed bags.

The goal is to replace manual transfer and palletizing operations with an automated line integrating motorized conveyors, sensors, and one or more industrial robots.

The system should ensure accurate and fast transfer of bags from the bagging machine to the palletizing area, while improving productivity, safety, and workstation ergonomics.

The project includes system modeling, selection of mechanical and robotic components, and simulation of the proposed solution using design and automation tools.

Required Skills:

- Mechanical design and 3D modeling (SolidWorks, CATIA),
- Industrial robotics (kinematics, trajectory planning, robot selection, simulation),
- Automation and control (PLC, Grafset, TIA Portal),
- Sensors and vision systems,
- Basic electrotechnics and pneumatics,
- Knowledge of industrial integration and manufacturing systems



MECHATRONICS

Reference: MECHA04

Subject 4 : Study and design of a Delta-based robotic system for the packaging of Agri-Food products

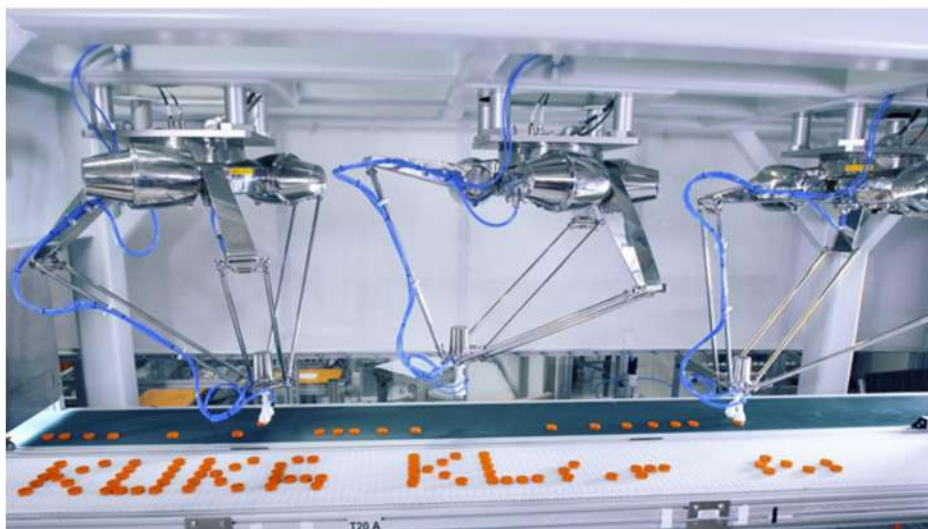
Description :

This project is part of the development of a robotic cell dedicated to the automatic packaging of agri-food products, aiming to enhance productivity, precision, and hygiene in the industrial process.

The main objective is to design and size a complete robotic system based on a Delta robot, integrating the mechanical structure of the cell, the product conveying system, the gripping mechanism, and the vision system for intelligent robot guidance.

Required Skills :

- Strong analytical and synthesis skills.
- Proficiency in 3D CAD software (SolidWorks, CATIA, or equivalent).
- Knowledge of structural mechanics and material strength.
- Basic understanding of parallel robot kinematics (Delta-type).
- Familiarity with gripping systems (suction cups, grippers, vacuum generators, etc.)
- Understanding of conveying systems and production logistics.



MECHATRONICS

Reference: MECHA05

Subject 5 : Thermal Analysis and CFD-Based Cooling Optimization of an Autonomous Solar Panel Cleaning Robot

Description :

The increasing deployment of autonomous solar panel cleaning robots introduces thermal management challenges, especially when the control, power, and actuation components are enclosed within compact aluminium housings exposed to outdoor conditions. These systems experience significant internal heat flux from motors, batteries, and electronics, combined with external solar radiation and ambient temperature variations, which can reduce performance, reliability, and component lifespan.

This project aims to perform a **comprehensive thermal and fluid dynamic study** of an autonomous solar panel cleaning robot. The work will involve:

- **1.Thermal source identification** and characterization of heat-dissipating components (motors, control board, Li-ion batteries, power electronics, sensors, etc.).
- **2.CFD modelling** of the internal and external heat transfer using software such as ANSYS Fluent, OPENFOAM and COMSOL.
- **3.Simulation of environmental effects**, including solar irradiation, wind flow, and ambient temperature variations.
- **4.Validation of thermal behaviour** under different operating and weather conditions.
- **5.Design and evaluation of cooling strategies**, such as heat sinks, natural/forced convection paths, ventilation, or phase-change materials.

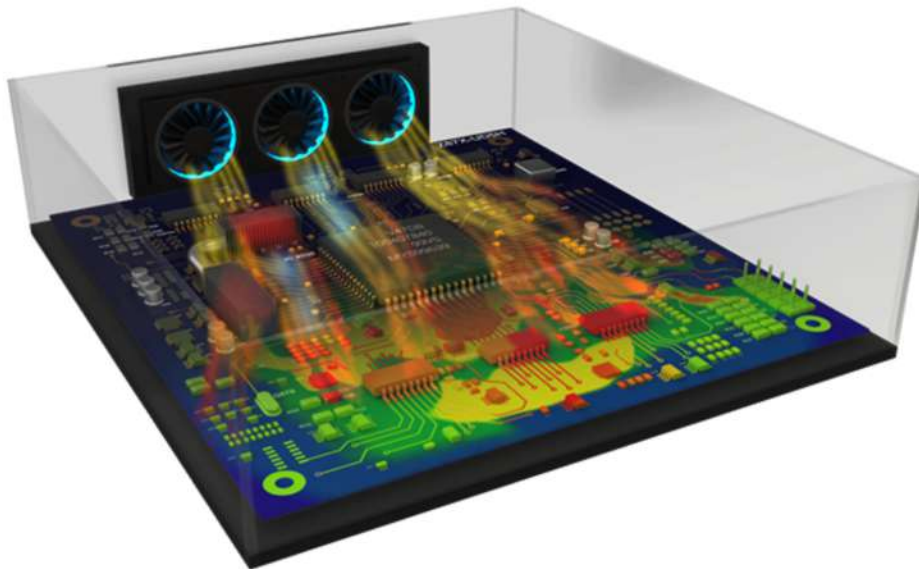
The final objective is to optimize the robot's thermal management system to ensure operational stability, minimize overheating, and enhance energy efficiency under real-world conditions.

Required profile:

- Background in Mechanical engineering with solid understanding of heat transfer, thermodynamics, and fluid mechanics.
- Strong interest and skills in Numerical Simulation and CAD design ideally with experience using ANSYS Fluent, COMSOL and OPENFOAM Simulation for thermal or CFD analysis.
- Analytical and problem-solving mindset – capable of linking simulation results with practical design improvements in a multidisciplinary system (mechanical, thermal, and electronic integration).

Skills & Tools:

- Thermal & fluid dynamics fundamentals (heat transfer, conduction, convection, radiation).
- CFD simulation tools: ANSYS Fluent, COMSOL and OPENFOAM.
- 3D CAD design (SolidWorks, CATIA).
- Material knowledge (thermal properties, insulation materials, etc.).
- Data analysis and post-processing (MATLAB or Python) for advanced cases if needed.
- Basic knowledge in electronics and power systems (for heat source estimation).



NAVIGATION

Reference: NAVI01

Subject 1 : Adaptive Path Planning and Obstacle Avoidance in Dynamic Outdoor Environments

Description :

Autonomous mobile robots deployed in outdoor environments must navigate through complex and constantly changing surroundings. Static path planning techniques often fail to handle unpredictable obstacles such as moving vehicles, humans, or dynamic terrain conditions. To ensure safe and efficient navigation, robots need adaptive planning mechanisms capable of perceiving changes in the environment and continuously updating their trajectory toward the goal. This research explores methods for real-time path adaptation and intelligent obstacle avoidance, focusing on achieving smooth, safe, and optimal navigation in highly dynamic scenarios.

Objective :

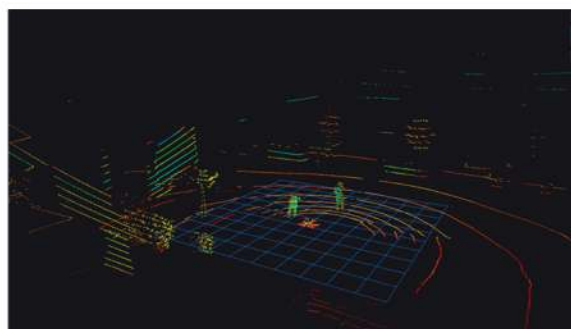
This internship project aims to develop an adaptive navigation system that enables a mobile robot to react intelligently to dynamic obstacles while maintaining an optimal trajectory toward its destination. The approach will combine perception data from multiple sensors to assess environmental changes and apply adaptive planning algorithms to ensure both safety and efficiency in outdoor operations.

Required Skills:

- Proficiency in Python and C++
- Experience with ROS 2
- Fundamental knowledge of motion planning and control systems

Recommended Skills:

- Familiarity with LiDAR, camera, or GPS-based perception
- Understanding of sensor fusion and real-time decision-making algorithms
- Knowledge of simulation tools for testing autonomous systems



NAVIGATION

Reference: NAVI02

Subject 2 : Multi-Task and Objective Orchestration for Autonomous Mobile Robots

Description :

Autonomous robots operating in real environments must perform a sequence of tasks that go beyond simple navigation such as exploring a map, reaching specific locations, and performing context-dependent actions. Efficient orchestration of these tasks requires a modular system capable of prioritizing, sequencing, and adapting behaviors according to mission objectives and environmental conditions. This research explores methods for developing a high-level task management framework that enables a robot to reason about its objectives, handle multiple goals, and make decisions dynamically based on real-time feedback.

Objective :

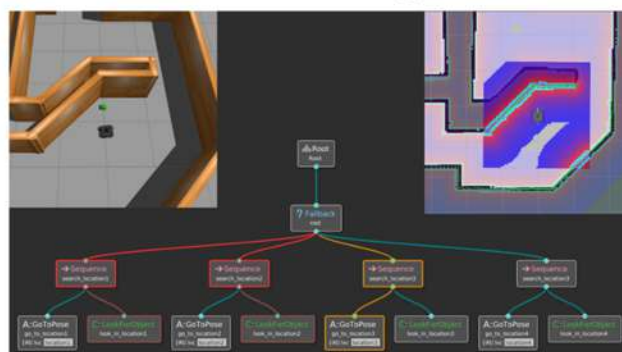
This internship project aims to design and implement a modular task orchestration framework that allows an autonomous robot to manage and execute multiple objectives adaptively. The system will incorporate decision-making mechanisms such as behavior trees or finite state machines (FSMs) to handle mission-level logic while accounting for variables such as environment state, resource availability, and robot performance.

Required Skills:

- Proficiency in Python and C++
- Experience with ROS 2
- Basic knowledge of state machines or behavior trees

Recommended Skills:

- Familiarity with robot perception
- Understanding of navigation basics
- Experience with Gazebo simulation for testing autonomous behaviors



FULL STACK

Reference: FULLSTACK01

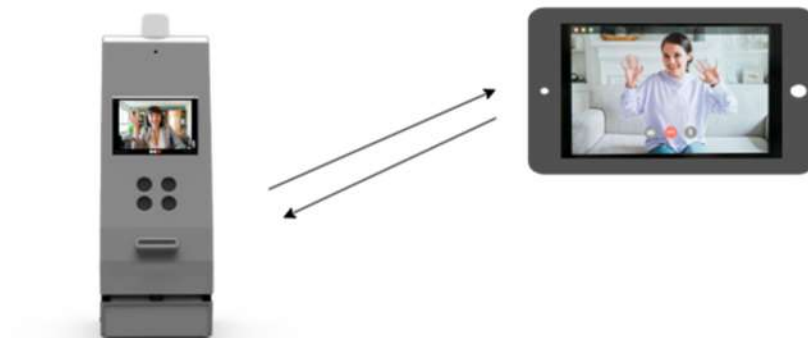
Subject 1 : Design and development of an application integrating a telepresence module for remote supervision and control.

Description :

In a context where remote operation and supervision are becoming key challenges in industrial, medical, and robotic domains, this project aims to design and develop a complete telepresence module. The module will enable real-time audio, video, and command transmission between a remote user and a physical or robotic platform. The intern will participate in the software architecture design, development of the telepresence module (streaming, control), and integration into an interactive supervision application. The project also includes building an intuitive user interface, securing communications, and validating system performance.

Required Skills:

- Proficiency in one or more programming languages: JavaScript, TypeScript, Python
- Familiarity with frameworks: React, Node.js
- Experience with communication protocols: WebRTC, WebSocket, MQTT
- Knowledge of MongoDB and version control tools (Git)
- Sensitivity to UI/UX design (Figma)
- Ability to document and test system performance
- Autonomy, rigor, and team spirit



FULL STACK

Reference: FULLSTACK02

Subject 2 : Design and Development of a Multi-Robot Control Platform for the PGuard Robot

Description :

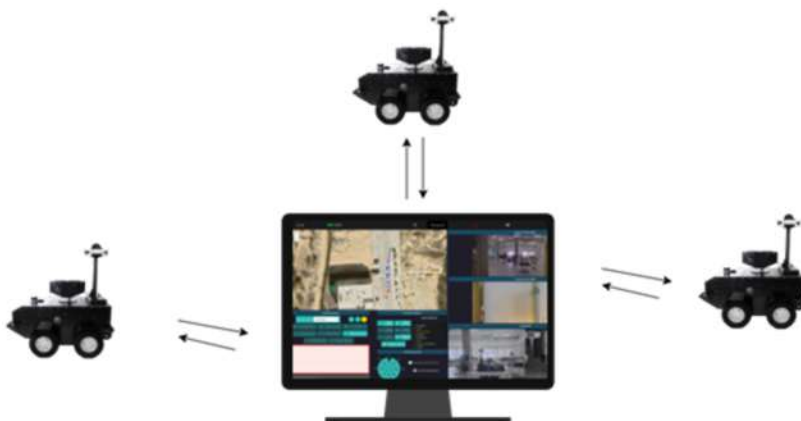
The aim of this project is to design and develop a centralized software platform for the control, monitoring, and coordination of multiple PGuard robots. The solution will enable efficient communication between robots and the operator, while optimizing mission management and resource allocation.

The project will include:

- Analyzing the architecture and functionalities of the PGuard robot.
- Designing a multi-robot system architecture (communication, supervision, task scheduling).
- Developing a real-time command and visualization interface.
- Implementing mission management and inter-robot communication features.
- Testing and validating the system on one or more PGuard robots.

Required Skills:

- Object-oriented programming
- Knowledge of web or mobile development frameworks (React, Angular)
- Familiarity with distributed or robotic systems (a plus)
- Understanding of network communication protocols (WebSocket, MQTT, REST)
- Experience with Linux environments and databases (MongoDB or PostgreSQL)



FULL STACK

Reference: FULLSTACK03

Subject 3 : Design and Development of a Supervision and Control Application for a solar panel cleaning robot

Description :

The goal of this project is to design and develop a distributed web application that enables the supervision and control of a solar panel cleaning robot. The application will be based on a microservices architecture, where each service manages a specific responsibility such as authentication, missions, telemetry, robot management, and notifications.

The application will provide an intuitive and responsive interface allowing users to monitor the robot's status in real time, including battery level, position, mission status, and alerts, and to send commands directly through the platform.

Required Skills:

- Frontend: Angular (RxJS, WebSocket, Chart.js)
- Backend: Spring Boot (microservices architecture)
- Messaging & IoT: Kafka, MQTT
- Database: MongoDB (NoSQL)
- Containerization & Deployment: Docker, Docker Compose



FULL STACK

Reference: FULLSTACK04

Subject 4 : Design and Multi-Environment Deployment of a Full-Stack Application

Description :

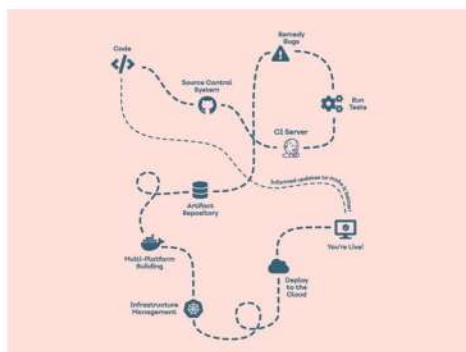
The goal of this project is to design and automate the deployment of a full-stack application composed of two main components:

- Backend: a modular microservices architecture.
- Frontend: a responsive application serving as both a web and mobile interface.
- The objective is to make the deployment modular, reproducible, and fully automated across two distinct environments:
- Development (DEV) Environment: dedicated to development, testing, and integration, executed locally for collaborative work and validation.
- Production (PROD) Environment: intended for large-scale deployment, orchestrated on a managed infrastructure with configuration, security, scalability, and monitoring management.

Each application will have its own configuration profiles adapted to each environment (development and production). An automated integration and deployment pipeline will handle the processes of building, testing, deploying, and continuously updating the application.

Required Skills :

- Backend: Spring Boot (microservices, JWT security)
- Frontend: Angular / Ionic
- Containerization & Orchestration: Docker, Docker Compose, Kubernetes, Helm
- CI/CD: Jenkins, Argo CD
- Messaging & Database: Kafka, MQTT, MongoDB
- DevOps Practices: Containerization, monitoring, and deployment automation



Reference: AI01

Subject 1 : Chatbot “Guardia” for security robot monitoring and natural communication

Description :

This project aims to develop an intelligent chatbot named “Guardia”, designed to assist in monitoring and interacting with the security robot PGuard. The chatbot will connect to the robot’s system to read and interpret log files in real time, providing users with meaningful insights into operational status, detected anomalies, and system health. The project integrates log analysis, real-time data monitoring, and AI-based conversational interaction, ultimately improving user accessibility and operational awareness in robotic security systems.

Required Skills :

- Python, ROS
- Experience with tools like OpenAI API, LangChain, Pydantic
- Basic knowledge of speech-to-text (STT) and text-to-speech (TTS) APIs,
- Ability to parse and analyze system or log files,



Reference: AI02

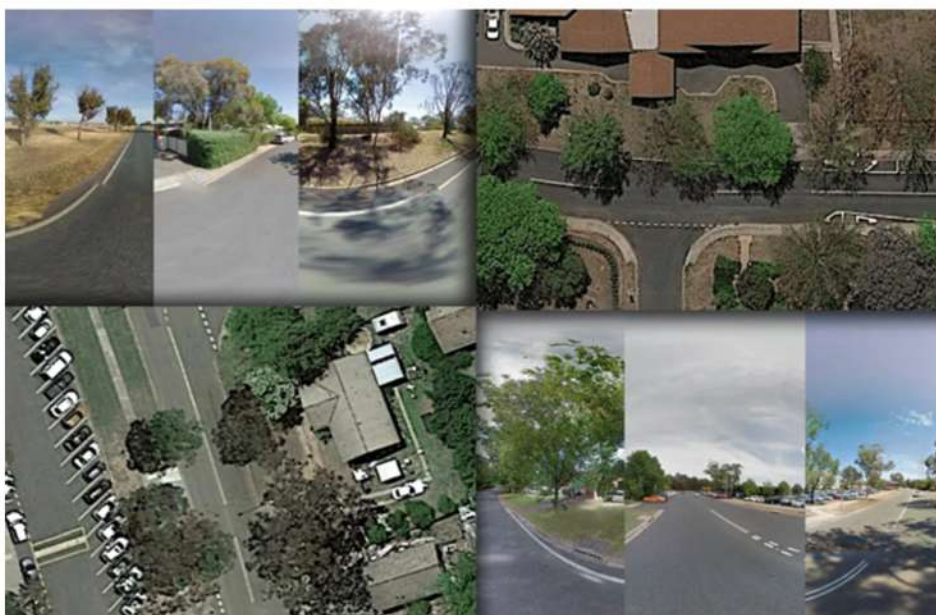
Subject 2 : LightGeo: Lightweight Deep Cross-View Model for Image-Based Geolocation

Description :

This project aims to design and implement a lightweight, transformer-based model capable of estimating the geographical location of a ground-level image by matching it with aerial or satellite images. The model will employ deep cross-view representation learning and hash-based encoding to create compact feature embeddings for both ground and aerial views, enabling fast and memory-efficient image retrieval.

Required Skills :

- Python, PyTorch, CNNs, Transformers,
- Image feature extraction, similarity learning, and cross-view matching concepts,
- Model optimization (quantization, pruning, knowledge distillation),
- Embedded Jetson AI deployment



PRODUCTION

Reference: PROD01

Subject 1 : Design of a Quick Changeover (SMED) System for Robot Maintenance

Description :

This project is part of the continuous improvement of maintenance processes for ENOVA Robotics' security robots. The main objective of this internship is to design and validate a SMED (Single Minute Exchange of Die) system to significantly reduce intervention time for changing and maintaining critical modules of the robot.

The project will include:

- Analysis of the current system and identification of maintenance bottlenecks
- Study of SMED standards and industrial benchmarking
- Mechanical design of a quick-release and changeover system for robot modules
- Simulation and prototyping
- Testing and validation on the P-Guard security robot

This internship will allow the candidate to contribute to the continuous improvement of industrial and maintenance processes while working within an innovative robotics engineering team.

Required Profile :

- Engineering student in Mechatronics / Industrial Engineering / Robotics
- Motivation, autonomy, analytical skills
- Interest in mobile robotics and industrial maintenance

Required Skills :

- 3D CAD (SolidWorks, CATIA, or equivalent)
- Mechanical and industrial design knowledge
- Basic automation and robotics knowledge
- Process analysis (Lean Manufacturing / SMED)
- Creativity and problem-solving skills



DESIGN COMMUNICATION

Reference: DESIGN01

Subject 1 : Creation of a New Visual Identity and Global Rebranding for Enova Robotics

Description :

The objective of this project is to develop a new graphic charter and a coherent brand identity, covering all the company's communication materials, including:

- Redesign of corporate and commercial presentations,
- Creation of product catalogs and marketing materials (posters, brochures, flyers),
- Development of presentation templates for internal use,
- Definition of a unified graphic style for social media visuals, the website, and official documents.

The intern will be involved in all stages of the creative process — from needs analysis and benchmarking to the design and presentation of final deliverables, contributing directly to the company's new branding strategy.

Required Skills :

- Proficiency in graphic design tools: Adobe Illustrator, Photoshop, Canva, , or equivalents,
- Strong sense of visual identity and brand design,
- Knowledge of visual communication and layout design,
- Ability to create coherent and aesthetic marketing materials,
- Creativity, attention to detail, and rigor,
- (Plus) Basic knowledge of motion design or UI/UX design.



DESIGN COMMUNICATION

Reference: DESIGN02

Subject 2 : Corporate Video Production and Visual Communication for Enova Robotics

Description :

The aim of this internship is to create engaging and professional video content that highlights the company's vision, products, expertise, and team culture.

The intern will be responsible for:

- Planning, filming, and editing promotional and documentary-style videos,
- Producing product demonstration videos showcasing Enova's robots and technologies,
- Creating short videos for social media platforms (LinkedIn, Instagram, YouTube, etc.),
- Collaborating with the marketing and design teams to ensure visual consistency with Enova's branding,
- Assisting in the development of a corporate audiovisual identity (intro/outro, transitions, tone, and music style).

This project will contribute directly to strengthening Enova Robotics' brand image and digital presence through high-quality storytelling and visual communication.

Required Skills :

- Proficiency in video editing software (Adobe Premiere Pro, After Effects, DaVinci Resolve, or similar),
- Knowledge of filming techniques (lighting, framing, camera setup),
- Creativity and a good sense of visual storytelling,
- Basic skills in motion design and sound editing,
- Ability to work autonomously and respect deadlines,
- (Plus) Experience in corporate communication or product videography.



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