NIS

ENGINEERING
INDUSTRIAL TECHNOLOGY
REAL IMPACT

# NIS PFE BOOK 2026-2027

## Final-Year Engineering Projects

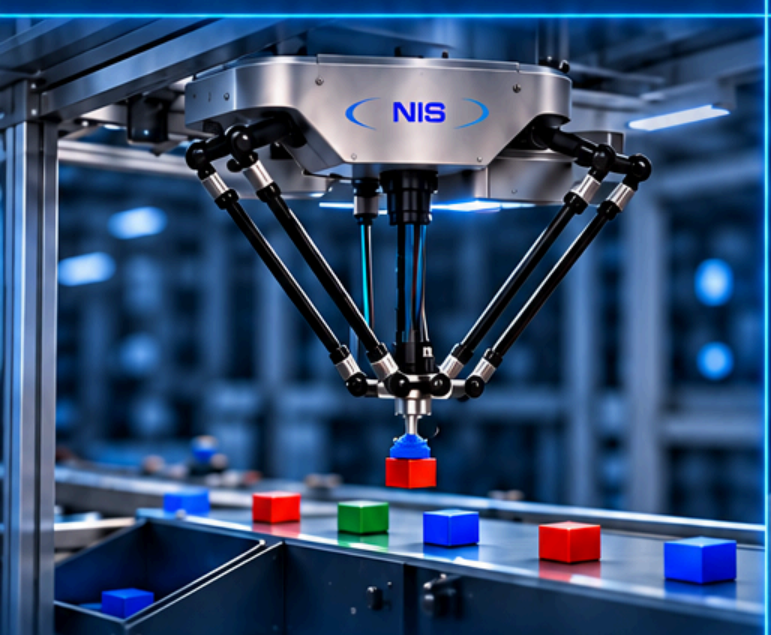
### Robotics Projects | AI Engineering Projects



INDUSTRIAL AMR




AGRICULTURAL AMR




DELTA ROBOT




COMPUTER VISION
VISUAL QUALITY INSPECTION

Northern Innovative Solutions

contact@nistunisia.com

CONTENTS

# Explore the projects

Two categories. Four final-year engineering projects.

## ROBOTICS PROJECTS

Mechanical design, simulation and control

### Industrial AMR 03

**Mechanical Design and Simulation**

CAD, mechanical calculations and ROS 2/Gazebo validation.

### Agricultural AMR 04

**Mechanical Design and Simulation**

Mobile platform for camera-based plant monitoring.

### Delta Robot 05

**Design, Simulation and Control**

Kinematics, color detection and pick-and-place control.

## AI ENGINEERING PROJECTS

Agricultural image data, annotation and model validation

### Computer Vision for Visual Quality Inspection 06

**Data Preparation, Annotation and Model Validation**

Agricultural image datasets, quality checks and baseline evaluation.

**HOW TO APPLY**

Send your CV, portfolio (if available) and a short motivation letter.

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INTERNSHIP OPPORTUNITY

# Internship – Mechanical Design and Simulation of an Industrial AMR

Join NIS and contribute to the development of a real industrial robotics platform, from mechanical design to simulation. Turn your engineering skills into real-world impact.



DESIGN
SIMULATE
INNOVATE

## THE PROJECT

Design a compact, robust and industrial-grade autonomous mobile robot intended for material transportation in professional environments. The focus of the internship is the mechanical design, validation and simulation of one AMR platform, from concept to a simulation-ready model.

## KEY OBJECTIVE

Develop a complete 3D CAD model of the AMR, perform the necessary mechanical calculations and prepare the robot for simulation. The final model must be ready for integration with ROS 2 and Gazebo.

## MAIN TASKS

- Study existing industrial AMR solutions
- Define the mechanical architecture and dimensions
- Select wheels, motors, gearboxes and key components
- Perform payload, torque and structural calculations
- Create the complete 3D CAD model (Fusion 360 preferred)
- Prepare engineering drawings and technical documentation
- Develop a simulation-ready URDF/Xacro model
- Integrate and test the robot in ROS 2 and Gazebo
- Validate basic movement and behavior in simulation
- Provide a final report with design choices and recommendations

## EXPECTED DELIVERABLES

- Complete 3D CAD model
- Technical drawings and main specifications
- Mechanical calculations (payload, torque, structure, etc.)
- URDF/Xacro model
- Gazebo simulation environment
- Demonstration of the robot in simulation
- Final technical report

## PROFILE

- Engineering student in Mechanical Engineering, Mechatronics, Robotics or a related field
- Strong interest in robotics and industrial applications
- Autonomous, motivated and curious
- Good problem-solving skills

## PREFERRED SKILLS

- Fusion 360 (preferred) or similar CAD software
- Mechanical design and basic structural analysis
- ROS 2 and Gazebo
- URDF / Xacro
- Basic robot kinematics and dynamics
- Python or C++ (an advantage)

## ABOUT NIS

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INTERNSHIP OPPORTUNITY

# Internship - Mechanical Design and Simulation of an Agricultural AMR

Join NIS to develop a mobile robot for plant monitoring. Design a robust platform for agricultural environments, from mechanical concept to simulation.




DESIGN
SIMULATE
INNOVATE

## THE PROJECT

Design an agricultural Autonomous Mobile Robot (AMR) for camera-based plant monitoring. The platform will support future analysis of crop health and signs of possible nutrient deficiencies, helping identify areas that may need attention. The internship focuses on the robot's mechanical design and simulation.

## KEY OBJECTIVE

Develop the complete 3D CAD model, perform the mechanical calculations and validate the platform in Gazebo. Provide a ROS 2-compatible model with camera mounts and space for electronics. AI-based crop analysis will be developed separately.

## MAIN TASKS

- Study terrain, crop-row spacing and ground clearance
- Define the chassis and drivetrain architecture
- Size motors and wheels; calculate torque and traction
- Check chassis strength, stability and sensor payload
- Design camera mounts and cable routing
- Plan battery space, electronics and weather protection
- Create the complete CAD model (Fusion 360 preferred)
- Prepare technical drawings and a bill of materials
- Build a ROS 2-compatible URDF/Xacro model
- Validate basic motion on representative terrain in Gazebo

## EXPECTED DELIVERABLES

- Complete 3D CAD model
- Technical drawings and bill of materials
- Mechanical calculations and component selection
- ROS 2-compatible URDF/Xacro model
- Gazebo simulation environment
- Robot motion demonstration in simulation
- Final technical report and handover documentation

## PROFILE

- Engineering student in Mechanical Engineering, Mechatronics, Robotics or a related field
- Interest in mobile robotics and agricultural technology
- Autonomous, motivated and curious
- Good problem-solving skills

## PREFERRED SKILLS

- Fusion 360 (preferred) or similar CAD software
- Mechanical design and basic structural analysis
- ROS 2 and Gazebo
- URDF / Xacro
- Basic robot kinematics and dynamics
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INTERNSHIP OPPORTUNITY

# Internship - Delta Robot for Vision-Based Object Sorting

## Design, Simulation and Control

Join NIS to build a robotic sorting system combining mechanical design, computer vision and motion control, from simulation to potential prototype integration.




### THE PROJECT

Design and simulate a Delta parallel robot that sorts small objects by color. An overhead RGB camera will detect objects and locate them in the workspace. The robot will pick each object and place it in the matching bin through a complete automated sorting cycle.

### KEY OBJECTIVE

Deliver an integrated ROS 2 and Gazebo system combining mechanical design, forward/inverse kinematics, camera calibration, OpenCV perception and motion control. Validate sorting in simulation first. Transfer the workflow to a physical prototype if hardware is available.

### MAIN TASKS

- Size the geometry, actuators and end-effector
- Create CAD and complete mechanical calculations
- Implement kinematics, workspace and reachability checks
- Model parallel links and closed-loop constraints
- Build the ROS 2/Gazebo scene and virtual camera
- Detect object colors and positions with OpenCV
- Calibrate image-to-robot coordinates with ROS TF
- Plan smooth motion with speed/acceleration limits
- Coordinate detection, gripping, transfer and sorting
- Validate sorting accuracy, cycle time and repeatability

### EXPECTED DELIVERABLES

- CAD model, drawings and mechanical calculations
- ROS 2 packages, URDF/Xacro and simulation assets
- Forward and inverse kinematics implementation
- OpenCV color detection and camera calibration
- Pick-and-place and sorting controllers
- Complete Gazebo sorting demonstration
- Source code, demo video and technical report
- Prototype integration, if hardware is available

### PROFILE

- Engineering student in Robotics, Mechatronics or a related mechanical, control or computing field
- Python and/or C++; Linux and Git
- Knowledge of kinematics and basic control systems
- Interest in mechanical design, vision and integration

### SKILLS AND TOOLS

- ROS 2, Gazebo, URDF/Xacro and RViz
- OpenCV, color detection and camera calibration
- Fusion 360 (preferred) or SolidWorks; 3D printing
- Robot kinematics and trajectory generation
- Motor drivers, encoders and microcontrollers (a plus)
- micro-ROS or industrial automation (a plus)

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AI ENGINEERING PROJECTS

# Internship - Computer Vision for Visual Quality Inspection

Prepare reliable agricultural image data for visual quality inspection.




## THE PROJECT

Prepare a representative, well-documented image dataset for agricultural product inspection. The main focus is data acquisition, annotation and quality assurance. Detailed application and inspection criteria will be defined with NIS.

## KEY OBJECTIVE

Deliver a clean, traceable and versioned dataset with reproducible preparation tools. Use a baseline computer vision model to evaluate data quality and identify gaps for further collection or annotation.

## MAIN TASKS

- Plan representative image collection
- Collect representative images and traceable metadata
- Write class definitions and annotation guidelines
- Label images and review ambiguous cases
- Clean data, remove duplicates and assess class balance
- Split data by physical sample and acquisition batch
- Build reproducible preprocessing and dataset checks
- Train a baseline model and analyze errors
- Document and version the dataset release

## EXPECTED DELIVERABLES

- Raw and annotated image dataset with metadata
- Acquisition protocol and annotation guidelines
- Reviewed labels and fixed train/validation/test splits
- Data cleaning, validation and export scripts
- Versioned dataset release and data-quality report
- Baseline model, evaluation code and error analysis
- Technical documentation and final demonstration

## PROFILE

- Final-year student in AI, Computer Science, Data Science or a related engineering field
- Interest in computer vision and careful experimental work
- Strong analytical, organizational and problem-solving skills

## PREFERRED SKILLS

- Python, OpenCV and machine learning fundamentals
- Image annotation tools and data quality assessment
- Git, reproducible workflows and structured data
- PyTorch or TensorFlow would be an advantage

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