ANCHOR(abbreviated title)

ANCHOR: Architecture for Networked Computing, Hardware & Operational Robotics

NautIQ Technologies Capstone Project 2026-2027

Sponsoring Company:

NAME: **NautIQ Technologies Inc.**
Address: 260 Child St, Warren, RI 02885
http://nautiq.tech

Company Overview:

NautIQ Technologies Inc. is a marine robotics and technology company developing intelligent automation solutions to modernize vessel maintenance operations. The company is creating an AI-powered robotic platform that combines electrical engineering, computer engineering, robotics, sensors, computer vision, and data analytics to automate the inspection and maintenance of marine vessels.

The NautIQ platform integrates autonomous mobile robotics, robotic manipulation, sensing technologies, embedded systems, and software intelligence to enable robotic systems to safely perform complex maintenance tasks in marine environments. The system requires the development and integration of hardware and software components, including sensor systems, robotic controls, communication interfaces, data processing, and intelligent decision-making algorithms.

Technical Director(s):

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Project Motivation:

Marine vessel maintenance remains a highly manual, labor-intensive process that requires significant time, specialized skills, and physical effort. Traditional inspection and maintenance methods often rely on human operators performing repetitive tasks in challenging environments, creating opportunities for improved safety, efficiency, and consistency through automation.

NautIQ Technologies Inc. is developing an intelligent robotic platform that combines robotics, embedded systems, sensors, computer vision, artificial intelligence, and data analytics to transform how marine maintenance is performed. The project aims to address complex engineering challenges involving autonomous systems, robotic control, real-time data collection, and secure communication between hardware and software components.

This capstone project provides Electrical and Computer Engineering students with the opportunity to apply their knowledge in a real-world technology development environment while contributing to the advancement of next-generation marine robotics. Students will gain hands-on experience designing, integrating, and testing engineering solutions involving embedded systems, sensors, automation, software development, and intelligent robotic systems.

Anticipated Best Outcome:

The anticipated best outcome of this capstone project is the successful design, development, and testing of the electrical and computer engineering architecture required to integrate NautIQ's robotic maintenance platform. The student team will design and develop custom electrical systems, including circuit boards, power management systems, communication interfaces, and control electronics required to connect and operate the autonomous mobile robot base, robotic arm, end effectors, sensors, and supporting hardware components.

The project will focus on hardware-software integration challenges, including embedded system design, motor and actuator control, sensor integration, communication protocols, safety systems, and real-time data exchange between robotic components. The team will validate the developed systems through laboratory testing and integration with NautIQ's prototype platform.

The completed project will provide a critical engineering foundation for NautIQ's next-generation marine robotics system while giving students hands-on experience designing, building, and testing complex electromechanical systems used in industrial automation and autonomous robotics.

Project Details:

Overall System Concept

NautIQ's autonomous marine maintenance platform is a robotic system designed to automate vessel inspection and maintenance tasks through the integration of robotics, embedded electronics, sensing technologies, and intelligent software.

The overall system consists of several interconnected subsystems, including an autonomous mobile robotic base, robotic arm, specialized end effectors, sensors, embedded controllers, power management systems, communication interfaces, and software platforms. The electrical and computer engineering components serve as the central integration layer that enables communication, coordination, and control between these subsystems.

The capstone project will focus on developing the electrical architecture required to connect and operate the robotic platform.

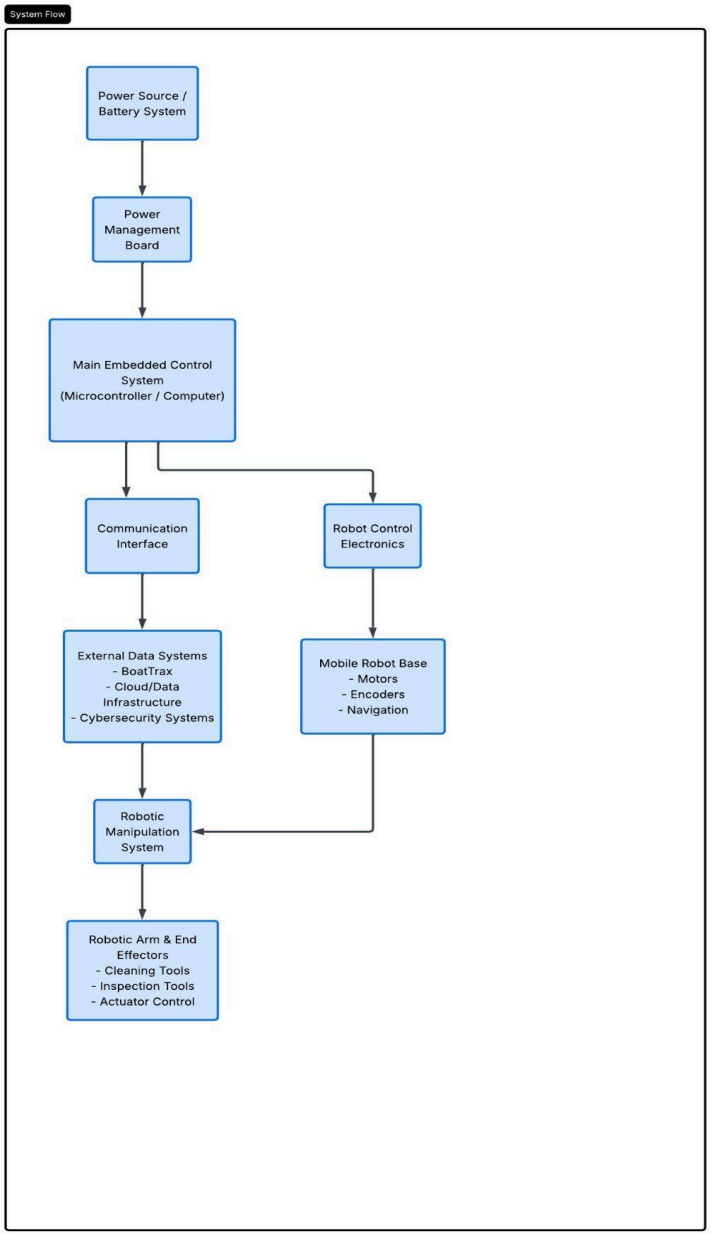
The system will collect real-time data from sensors and robotic components, process information through embedded computing systems, and enable coordinated operation of the mobile platform, robotic arm, and end effectors. The developed electrical infrastructure will provide the foundation for future integration of artificial intelligence, computer vision, and autonomous decision-making capabilities.

The final system will demonstrate a scalable hardware and software architecture capable of supporting NautIQ's next-generation robotic marine maintenance platform.

Block Diagram:

The overall system architecture consists of interconnected hardware and software subsystems responsible for power management, sensing, control, communication, and robotic operation.

System Flow:


System Flow
Power Source / Battery System
Power Management Board
Main Embedded Control System (Microcontroller / Computer)
Communication Interface
Robot Control Electronics
External Data Systems
- BoatTrax
- Cloud/Data Infrastructure
- Cybersecurity Systems
Mobile Robot Base
- Motors
- Encoders
- Navigation
Robotic Manipulation System
Robotic Arm & End Effectors
- Cleaning Tools
- Inspection Tools
- Actuator Control

The capstone project will focus primarily on the electrical and computer engineering layers of the architecture, sensor interfaces, communication systems, and hardware integration between the robotic base, robotic arm, and end effectors.

Hardware/Electrical Tasks:

Key hardware and electrical tasks include:

- **Electrical System Architecture Design**
  - Develop the overall electrical architecture for the robotic platform.
  - Define power distribution, communication pathways, control interfaces, and safety requirements between system components.
- **Power Management and Distribution**
  - Design power distribution systems to support the mobile robotic base, robotic arm, sensors, embedded computers, and end effectors.
  - Implement voltage regulation, protection circuits, monitoring, and safe power management.
- **Robot Base and End Effector Integration**
  - Develop electrical interfaces between the autonomous mobile base, robotic arm, and specialized maintenance end effectors.
  - Support actuator control, feedback systems, and communication between robotic components.

The successful completion of these tasks will provide NautIQ with a scalable electrical and embedded systems foundation required for future autonomous marine robotics development.

Firmware/Software/Computer Tasks:

The Electrical and Computer Engineering capstone team will work alongside NautIQ's Senior Software Engineer to support the development and integration of firmware, software interfaces, and computer systems required for the company's autonomous marine robotics platform. The team will contribute to the software and embedded systems architecture that enables communication, control, monitoring, and data exchange between the robotic base, robotic arm, end effectors, sensors, and digital platforms.

Key firmware, software, and computer engineering tasks include:

- **Hardware-Software Integration**
  - Assist with integrating electrical boards, sensors, robotic components, and embedded computing systems.
  - Support communication between the mobile robotic base, robotic arm, end effectors, and onboard control systems.
- **Communication and Interface Development**
  - Support the implementation and testing of communication protocols between system components.
  - Assist with developing software interfaces that enable reliable data exchange between hardware subsystems.
- **Cybersecurity**
  - Assist with identifying cybersecurity risks across hardware, software, communication systems, and connected devices.
  - Implement basic authentication, access controls, and secure data handling for the robotic system.
  - Support testing of system security and identifying vulnerabilities in communication and software interfaces.

Through collaboration with NautIQ's Senior Software Engineer, the students will gain hands-on experience applying computer engineering and software development principles to a real-world autonomous robotics platform while contributing to the advancement of marine automation technology.

Composition of Team:

2 Electrical Engineers & 1 Computer Engineer

Skills Required:

Electrical Engineering Skills Required:

Students should have foundational knowledge in:

- Basic circuit analysis and electronic components
- Electrical measurement and testing techniques
- Microcontroller and embedded hardware fundamentals
- Sensor integration concepts
- Power systems and voltage regulation fundamentals
- Basic PCB design concepts
- Electrical troubleshooting and system testing
- Basic mechanical/robotics system

Computer Engineering Skills Required:

Students should have foundational knowledge in:

- Programming fundamentals (C/C++ and/or Python)
- Embedded systems concepts
- Microcontroller programming
- Hardware-software integration
- Basic communication protocols
- Software development and debugging practices
- Data handling and computer systems fundamentals
- Basic cybersecurity concepts for connected systems

Students will expand these skills throughout the capstone project while working under the guidance of NautIQ's engineering team and faculty advisors.

Anticipated Best Outcome's Impact on Company's Business, and Economic Impact

The successful completion of this capstone project will provide NautIQ Technologies Inc. with critical engineering advancements toward the development of its autonomous robotic platform for blue technology applications. The electrical and computer engineering solutions developed through this project will help establish the hardware and software foundation required to integrate the robotic base, robotic arm, end effectors, sensors, and future intelligent automation capabilities.

By developing and validating key electrical systems, communication interfaces, and hardware integration methods, the project will accelerate NautIQ's research and development timeline, reduce technical risk, and support future prototype advancement and commercialization efforts.

The project has the potential to contribute to economic growth within Rhode Island's blue economy and emerging technology sectors by supporting the development of innovative robotics and automation solutions for ocean-related industries. As a state with a strong maritime heritage and growing focus on blue technology innovation, Rhode Island provides an ideal environment for advancing technologies that improve marine operations, sustainability, and workforce capabilities.

NautIQ's technology has the potential to create new opportunities in engineering, robotics, software development, advanced manufacturing, and marine technology while strengthening Rhode Island's position as a leader in blue technology innovation. The collaboration between NautIQ and academic engineering programs will help develop a skilled workforce while accelerating the development of next-generation solutions for ocean industries.

The project will also support the growth of Rhode Island's innovation ecosystem by connecting students, researchers, and emerging technology companies to address real-world engineering challenges and develop commercially viable technologies.

Broader Implications of the Best Outcome on the Company's Industry:

The successful development of NautIQ's autonomous robotic platform has the potential to establish a new standard for vessel maintenance by introducing robotics, automation, and intelligent systems into an industry that has historically relied on manual processes. By creating a reliable and scalable robotic solution for vessel inspection and maintenance, NautIQ aims to improve operational efficiency, consistency, safety, and transparency across marine service operations.

The initial focus of NautIQ's technology development is to establish itself as the leading robotics automation platform for marine maintenance. By deploying robotic systems that perform consistent, repeatable, and data-driven maintenance activities, NautIQ will create the foundation for transforming how vessels are serviced and maintained throughout their lifecycle.

Following the successful adoption of its robotics platform, NautIQ plans to further expand its industry impact through BoatTrax, a digital vessel intelligence platform designed to capture, organize, and analyze verified maintenance data generated through robotic operations and service activities. By creating a trusted maintenance history for vessels, BoatTrax has the potential to provide valuable insights across the broader marine ecosystem, including yacht owners, insurance providers, yacht brokers, manufacturers, and service organizations.

Access to reliable maintenance data could improve decision-making, support more accurate vessel assessments, enhance risk evaluation, and increase transparency throughout the lifecycle of marine assets. Through the combination of robotics, automation, and data intelligence, NautIQ aims to move the industry toward a more connected, efficient, and technology-driven future.

This advancement will contribute to the growth of the blue technology ecosystem, strengthen Rhode Island's position as a leader in maritime innovation, and demonstrate how robotics and data platforms can transform traditional industries.

Appendix A: AI Use Policy – NautIQ Technologies Capstone Project 2026-2027

Allowed

- Students may use AI tools for

  ☑ brainstorming support
  ☑ concept development
  ☑ literature and publicly available documentation review

  ☐ software development

  ☐ debugging

  ☐ data analysis

  ☑ test development
  ☑ non-proprietary paragraph editing
  ☑ non-proprietary single-slide formatting

  ☐ preparation of project deliverables

  ☑ note taking or transcription of meetings

  ☐ Others: _____

Not Allowed

- Using AI in violation of university policies, applicable laws, or course-specific rules identified by capstone instruction team and project-specific rules identified by the technical directors.

- Entering proprietary, confidential, personally identifiable, security-sensitive, or otherwise restricted information into an AI system without authorization.
- Submitting AI-assisted work without understanding, reviewing, verifying, and appropriately disclosing its use.
- Submitting entire documents or presentations to an AI system for editing or formatting.
- Any unchecked items from the allowed list above.

Requirements

- If any use is allowed, AI tools may only be used to enhance, but not replace, students' technical reasoning, engineering judgment, and understanding. Students must be able to explain, justify, and defend all submitted designs, code, analyses, test results, documentation, and conclusions.
- During the first two weeks of the project, the student team shall work with the Technical Directors to: identify any proprietary or confidential information that may be involved in the project; determine what information may or may not be shared with AI systems; identify the AI tools, models, accounts, and configurations approved for project use; and document any project-specific restrictions or approval requirements.
- Students shall transparently document the uses of AI using the URI CYPHER AI Usage Marking guidelines (https://web.uri.edu/cypher/ai-marking/). A workshop is planned for September to familiarize students with these guidelines.
- Students retain full professional responsibility for all design decisions, analyses, implementations, testing, documentation, presentations, and final deliverables, regardless of whether AI tools contributed to the work.