

PATENT SPECIFICATION

Arctic Robot Maintenance System

Patent No. PDR-2022-0147

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ABSTRACT

A system and method for autonomous maintenance of robotic systems operating in extreme cold environments, comprising a self-diagnostic module, thermal management subsystem, and predictive maintenance algorithms specifically designed for temperatures below -40 C. The system enables continuous operation of autonomous mobile robots in arctic and sub-arctic industrial environments while maintaining optimal performance parameters.

BACKGROUND OF THE INVENTION

[0001] Autonomous mobile robots operating in extreme cold environments face unique challenges related to mechanical wear, battery performance, and system reliability. Traditional maintenance approaches become ineffective below certain temperature thresholds, particularly in industrial freezer and cold storage environments where temperatures can reach -40 C or lower.

[0002] Existing solutions fail to address the specific requirements of cold-environment robotics, including thermal stress on components, lubricant viscosity changes, and sensor degradation under frost conditions.

SUMMARY OF THE INVENTION

[0003] The present invention provides a comprehensive maintenance system for arctic-capable robots, comprising:

- Self-diagnostic thermal monitoring system
- Predictive maintenance algorithms optimized for cold environments
- Automated component stress analysis
- Smart defrosting protocols
- Cold-resistant lubricant distribution system

DETAILED DESCRIPTION

Thermal Management Subsystem

[0004] The thermal management subsystem includes:

- (a) Multiple temperature sensors strategically placed at critical points
- (b) Active heating elements with intelligent power management
- (c) Thermal isolation zones for sensitive components
- (d) Dynamic thermal load balancing algorithms

Predictive Maintenance Module

[0005] The predictive maintenance system comprises:

- (a) Machine learning algorithms trained on cold-environment operation data
- (b) Real-time component wear analysis
- (c) Automated maintenance scheduling based on environmental conditions
- (d) Integration with IceNav(TM) navigation platform

Self-Diagnostic Capabilities

[0006] The self-diagnostic system includes:

- (a) Continuous monitoring of:
 - Actuator performance
 - Battery efficiency
 - Sensor accuracy
 - Drive system integrity
- (b) Automated fault detection and classification
- (c) Remote diagnostic capabilities

CLAIMS

A system for maintaining autonomous robots in cold environments, comprising:

- (a) A thermal management subsystem operating between -60 C and +25 C
- (b) Self-diagnostic modules for component monitoring
- (c) Predictive maintenance algorithms optimized for sub-zero operations

The system of claim 1, wherein the thermal management subsystem includes:

- (a) Multiple temperature sensors
- (b) Active heating elements
- (c) Thermal isolation zones

The system of claim 1, further comprising machine learning algorithms trained specifically for cold environment operations.

DRAWINGS

[Figure 1: System Architecture Diagram]

[Figure 2: Thermal Management Flow]

[Figure 3: Component Placement Schematic]

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FIELD OF INVENTION

[0007] This invention relates to autonomous robot maintenance systems, specifically systems designed for extreme cold environment operations in industrial and logistics applications.

PRIOR ART REFERENCES

US Patent 10,234,567 - "Cold Environment Robotics System"

US Patent 10,876,543 - "Thermal Management for Industrial Robots"

US Patent Application 2021/0123456 - "Predictive Maintenance Systems"

EXECUTION

IN WITNESS WHEREOF, the undersigned has executed this patent application as of the date first written above.

/s/ Dr. Elena Frost

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Dr. Elena Frost

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Date: March 15, 2022

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