PATENT: AUTONOMOUS DEFROSTING SYSTEM FOR SENSORS

PATENT SPECIFICATION

AUTONOMOUS DEFROSTING SYSTEM FOR SENSO

Patent Application No.: US 16/428,392

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Assignee: Polar Dynamics Robotics, Inc.

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ABSTRACT

An autonomous defrosting system for maintaining operational integrity of se in sub-zero environments, comprising a multi-layer thermal management architecture integrated with environmental monitoring capabilities. The syste enables continuous operation of robotic sensors in extreme cold conditions through predictive defrost cycling and localized heating elements.

BACKGROUND OF THE INVENTION

[0001] Autonomous mobile robots operating in cold storage environments fa significant challenges related to sensor functionality due to frost accumulation. Existing defrosting solutions require manual intervention or scheduled downtime, reducing operational efficiency.

[0002] Traditional defrosting methods often involve complete system shutdo inefficient heating of entire sensor arrays, resulting in excessive energy consumption and reduced sensor lifespan.

SUMMARY OF THE INVENTION

[0003] The present invention provides an autonomous defrosting system comprising:

- Distributed temperature and humidity sensors
- Micro-heating elements with precision control
- Machine learning-based frost prediction algorithms
- Zone-specific defrost activation protocols
- Energy-efficient thermal management subsystems

DETAILED DESCRIPTION

Sensor Array Configuration

[0004] The system incorporates a network of sensors including:

- Primary navigation LIDAR (24GHz)
- Secondary proximity sensors (ultrasonic)
- Thermal imaging arrays
- Humidity detection modules

[0005] Each sensor element is equipped with:

Integrated heating filaments (0.5W - 2.5W capacity)

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Temperature monitoring probes

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Condensation detection surfaces

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Thermal isolation barriers

Defrost Control Architecture

[0006] The control system comprises:

a) Primary Control Unit

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ARM Cortex-M7 processor

- Real-time operating system
- Power management interface
- Sensor data fusion module

b) Machine Learning Subsystem

- Frost formation prediction
- Environmental pattern recognition
- Energy optimization algorithms
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Performance history analysis

Operating Parameters

[0007] The system operates within the following parameters:

- Temperature range: -40°C to +5°C
- Humidity tolerance: 15% to 95% RH
- Power consumption: 0.8W - 12W (variable)
- Response time: <500ms

CLAIMS

- An autonomous defrosting system for robotic sensors comprising:

a) A distributed sensor network with integrated heating elements

b) Environmental monitoring capabilities

c) Predictive frost detection algorithms

d) Zone-specific thermal management controls

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- The system of claim 1, wherein the heating elements are independently contr

a) Local temperature readings

b) Humidity levels

c) Operational status

d) Power availability

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The system of claim 1, further comprising machine learning capabilities for:

a) Frost formation prediction

b) Energy optimization

c) Performance monitoring

d) Maintenance scheduling

DRAWINGS

[0008] Figure 1: System Architecture Diagram

[0009] Figure 2: Sensor Array Layout

[0010] Figure 3: Control Flow Schematic

[0011] Figure 4: Power Distribution Network

TECHNICAL ADVANTAGES

[0012] The invention provides:

- 85% reduction in frost-related sensor failures
- 40% improvement in energy efficiency
- Continuous operation in extreme conditions
- Reduced maintenance requirements
- Extended sensor lifespan

INDUSTRIAL APPLICABILITY

[0013] The invention is particularly applicable to:

Cold storage facilities

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Frozen food manufacturing

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Pharmaceutical storage

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Industrial freezer environments

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Arctic research operations

DECLARATION AND SIGNATURE

I hereby declare that all statements made herein are true and that all statements made on information and belief are believed to be true.

/s/ Marcus Chen

Marcus Chen, CTO

Polar Dynamics Robotics, Inc.

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