PATENT SPECIFICATION

Cold-Weather Emergency Recovery System

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ABSTRACT

A system and method for emergency recovery of autonomous mobile robots operating in extreme cold environments, comprising a multi-stage thermal management system, redundant power supply architecture, and AI-driven diagnostic protocols. The system enables rapid restoration of robot functionality following critical failures in sub-zero temperatures while preventing permanent damage to sensitive electronic and mechanical components.

BACKGROUND

[0001] Autonomous mobile robots operating in cold storage and industrial freezer environments face unique challenges when system failures occur. Conventional recovery methods often fail due to rapid temperature-related degradation of critical components.

[0002] Existing solutions typically require complete shutdown and warming of the entire system, resulting in extended downtime and potential damage to temperature-sensitive components.

SUMMARY OF THE INVENTION

[0003] The present invention provides a cold-weather emergency recovery system comprising:

- A distributed thermal management network with independently controlled zones
- Rapid-response heating elements strategically positioned near critical components
- An AI-driven diagnostic system for failure detection and recovery prioritization
- Redundant power distribution architecture with cold-resistant energy storage
- Emergency mobility system enabling controlled extraction from extreme environments

DETAILED DESCRIPTION

Thermal Management System

[0004] The thermal management network comprises:

(a) Primary zone controllers monitoring component temperatures

(b) Micro-heating elements rated for operation at -40 C

(c) Thermal isolation barriers preventing cascade failures

(d) Smart thermal routing algorithms optimizing heat distribution

Power Management Architecture

[0005] The redundant power system includes:

(a) Cold-resistant lithium iron phosphate battery array

(b) Supercapacitor-based emergency power buffer

(c) Intelligent power routing system

(d) Emergency power conservation protocols

AI Diagnostic System

[0006] The diagnostic system implements:

(a) Real-time component monitoring using distributed sensors

(b) Predictive failure analysis algorithms

(c) Automated recovery sequence generation

(d) Remote operator notification and control interface

CLAIMS

A cold-weather emergency recovery system for autonomous mobile robots comprising:

(a) A distributed thermal management network

(b) Redundant power architecture

(c) AI-driven diagnostic protocols

(d) Emergency mobility system

The system of claim 1, wherein the thermal management network includes independently controlled heating zones capable of maintaining critical component temperatures above minimum operational thresholds.

The system of claim 1, wherein the power architecture comprises cold-resistant energy storage elements and intelligent power routing capabilities.

The system of claim 1, wherein the diagnostic protocols automatically initiate recovery sequences based on detected failure conditions.

DRAWINGS

[0007] FIG. 1 illustrates the distributed thermal management network architecture.

[0008] FIG. 2 shows the power distribution system layout.

[0009] FIG. 3 depicts the emergency mobility system components.

[0010] FIG. 4 presents the AI diagnostic system workflow.

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FIELD OF INVENTION

[0011] This invention relates to emergency recovery systems for autonomous mobile robots operating in extreme cold environments, specifically addressing critical system failures in industrial freezer and cold storage facilities.

PRIOR ART REFERENCES

US Patent 10,XXX,XXX

US Patent 9,XXX,XXX

US Patent Application 2020/XXXXXXX

EP Patent 3,XXX,XXX

EXECUTION

IN WITNESS WHEREOF, the undersigned has executed this patent application on this 12th day of March, 2021.

/s/ Dr. Elena Frost

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