

AUTONOMOUS COLD WEATHER OPERATIONS PATENT

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UNITED STATES PATENT APPLICATION NO. 16/78

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Assignee: Polar Dynamics Robotics, Inc.

ABSTRACT

A system and method for autonomous mobile robot operation in extreme cold environments, comprising temperature-hardened navigation systems,

chassis designs, and proprietary cold-resistant power management systems. This invention enables reliable robotic automation in sub-zero conditions through integrated thermal management, specialized sensor arrays, and adaptive control algorithms optimized for cold-weather performance.

BACKGROUND OF INVENTION

[0001] Autonomous mobile robots (AMRs) operating in cold storage environments face significant challenges related to battery performance, sensor reliability, and mechanical system operation at low temperatures. Conventional AMRs experience degraded performance or complete failure when operating in sub-zero conditions.

[0002] Current solutions fail to adequately address the combined challenges of power system efficiency, sensor accuracy, and mechanical reliability in cold environments, particularly in industrial freezer and cold storage

applications where temperatures routinely reach -30 C or lower.

SUMMARY OF INVENTION

[0003] The present invention provides systems and methods for enabling autonomous robot operation in extreme cold environments through:

- a) A proprietary BlueCore(TM) thermal management system that maintains components within optimal operating temperature ranges;
- b) Cold-resistant sensor arrays utilizing redundant measurement systems and heated housings;
- c) Adaptive navigation algorithms that compensate for environmental sensor data;
- d) Reinforced chassis design incorporating specialized materials and insulation zones.

DETAILED DESCRIPTION

1. Thermal Management System

[0004] The BlueCore(TM) thermal management system comprises:

- 1 An insulated central computing core maintaining 15-25 C operating
- 2 Multi-zone heating elements with intelligent power distribution
- 3 Temperature monitoring array with predictive control algorithms
- 4 Passive thermal barriers and active heat exchange systems

2. Sensor Systems

[0005] The cold-resistant sensor array includes:

- 1 Heated LIDAR housings with condensation prevention
- 2 Redundant inertial measurement units with temperature compensation
- 3 Infrared proximity sensors with automated calibration
- 4 Vision systems utilizing heated optical elements

3. Navigation Architecture

[0006] The adaptive navigation system features:

- 1 Environmental condition monitoring and route optimization
- 2 Dynamic speed adjustment based on surface conditions
- 3 Real-time sensor data validation and fusion
- 4 Fail-safe protocols for extreme temperature events

4. Mechanical Systems

[0007]-The reinforced chassis incorporates:

- 1 Composite materials rated for -40 C operation
- 2 Sealed bearing systems with cold-specific lubricants
- 3 Impact-resistant exterior panels with thermal isolation
- 4 Modular component design for maintenance access

CLAIMS

A system for autonomous mobile robot operation in cold environments:

- a) A thermal management system maintaining critical component temperatures
- b) Cold-resistant sensor arrays with redundant measurement capabilities
- c) Adaptive navigation algorithms optimized for low-temperature operation
- d) Reinforced mechanical systems designed for sub-zero conditions

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

- a) An insulated computing core
- b) Multi-zone heating elements
- c) Temperature monitoring arrays
- d) Active heat exchange systems

[Claims 3-20 continued...]

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ASSIGNMENT

All rights, title, and interest in this patent application are assigned to P
Dynamics Robotics, Inc., a Delaware corporation, by written assignment
on March 14, 2019, and recorded in the United States Patent and Tra
Office.

DECLARATION

I hereby declare that I am the original inventor of the subject matter w
claimed and for which a patent is sought; that I have reviewed and un
the contents of the above-identified specification, including the claims
that all statements made herein of my own knowledge are true and th
statements made on information and belief are believed to be true.

Executed on: March 15, 2019

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