ARCTIC-READY POWER MANAGEMENT PATENT

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Assignee: Polar Dynamics Robotics, Inc.

ABSTRACT

A system and method for managing power consumption in autonomou
operating in sub-zero environments, comprising a temperature-adapti
distribution network, cold-resistant battery cells, and an intelligent pow

management controller that optimizes energy usage based on environ
conditions and operational demands.

BACKGROUND OF THE INVENTION

[0001] Autonomous mobile robots operating in extreme cold environm
unique challenges related to power management and battery perform
Traditional lithium-ion battery systems experience significant degrada
capacity and charging capability at temperatures below -20 C, limiting
practical application in cold storage and arctic environments.

[0002] Existing solutions fail to address the complex interplay betwee
temperature fluctuations, power consumption patterns, and autonomo
requirements in industrial freezer settings.

SUMMARY OF THE INVENTION

[0003] The present invention provides a novel power management sy
specifically designed for autonomous mobile robots operating in extre
environments. The system comprises:

(a) A multi-layer thermal isolation architecture for critical power compo

(b) Advanced battery chemistry optimized for sub-zero performance;

(c) Intelligent power routing algorithms that dynamically adjust power
distribution based on real-time temperature data;

(d) Predictive thermal management systems that anticipate and preve
performance degradation.

DETAILED DESCRIPTION

1. System Architecture

[0004] The power management system includes:

1. Temperature-Resistant Battery Assembly

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Proprietary lithium iron phosphate (LiFePO4) cells modified for -40 C

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Multi-layer thermal insulation system with vacuum-sealed compartme

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Integrated heating elements with closed-loop temperature control

2. Power Distribution Network

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Redundant power buses with cold-resistant conductors

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Smart switching matrix for optimal power routing

- Temperature-compensated voltage regulators

3. Control System

- Microprocessor-based power management controller
- Real-time temperature monitoring across 16 zones
- Adaptive power allocation algorithms

2. Operating Parameters

[0005] The system maintains optimal performance under the following

1. Temperature Range

Operational: -40 C to +50 C

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Storage: -50 C to +60 C

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Charging: -30 C to +45 C

2. Power Specifications

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Nominal voltage: 48V DC

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Peak current: 80A

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Continuous current: 40A

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Battery capacity: 960Wh

3. Novel Features

[0006] Key innovations include:

1. BlueCore(TM) Technology

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Proprietary battery cell chemistry with arctic-grade electrolyte

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Advanced thermal management algorithms

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Predictive power optimization based on usage patterns

2. Safety Systems

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Multiple redundant temperature sensors

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Emergency power shutdown mechanisms

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Fault detection and isolation systems

CLAIMS

A power management system for autonomous mobile robots comprisi

(a) A temperature-resistant battery assembly capable of operation bel

(b) An intelligent power distribution network with adaptive routing capabilities;

(c) A control system implementing predictive thermal management alg

The system of claim 1, wherein the battery assembly includes:

(a) Modified LiFePO4 cells with arctic-grade electrolyte;

(b) Multi-layer thermal isolation architecture;

(c) Integrated heating elements controlled by closed-loop feedback.

The system of claim 1, further comprising:

(a) Real-time temperature monitoring across multiple zones;

(b) Dynamic power allocation based on environmental conditions;

(c) Predictive maintenance capabilities.

INVENTORS

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PRIORITY CLAIM

This application claims priority to U.S. Provisional Application No. 63/2

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GOVERNMENT RIGHTS

[0007] This invention was made with government support under Contr
NSF-SBIR-2145789 awarded by the National Science Foundation. Th
certain rights in the invention.