PATENT SPECIFICATION

Ice Detection and Avoidance System for Autonomous Mobile Robots

Patent No. US 11,842,XXX B2

Filing Date: March 15, 2019

Issue Date: January 11, 2022

ABSTRACT

A system and method for detecting and avoiding ice formation in autonomous mobile robots operating in cold environments. The system comprises multiple integrated sensors, thermal imaging arrays, and proprietary algorithms to identify ice accumulation patterns and adjust robot navigation and operation parameters accordingly. The invention enables reliable autonomous operation in sub-zero environments while preventing mechanical failures and navigation errors caused by ice formation.

BACKGROUND OF THE INVENTION

[0001] Autonomous mobile robots (AMRs) operating in cold storage and freezer environments face significant challenges related to ice accumulation on critical components. Traditional AMR systems lack effective mechanisms for detecting and responding to ice formation, leading to reduced reliability and potential system failures.

[0002] Existing solutions typically rely on basic temperature sensors and preset operational parameters that do not account for variable environmental conditions or localized ice formation patterns. This invention addresses these limitations through an advanced multi-sensor approach combined with adaptive control algorithms.

SUMMARY OF THE INVENTION

[0003] The present invention provides a comprehensive ice detection and avoidance system comprising:

- Distributed thermal sensor arrays
- Infrared imaging modules
- Proprietary pattern recognition algorithms
- Adaptive navigation controls

- Real-time path optimization based on ice risk assessment

[0004] The system continuously monitors environmental conditions and robot component status to predict, detect, and respond to ice formation risks before they impact operational performance.

DETAILED DESCRIPTION

[0005] Sensor Configuration

The system employs a network of high-precision temperature and humidity sensors strategically positioned across the robot chassis. These sensors communicate with a central processing unit through a redundant data bus system operating at -40 C to +85 C.

[0006] Detection Algorithm

The proprietary IceNav(TM) algorithm processes sensor data using machine learning models trained on extensive cold-environment operational data. The algorithm identifies ice formation patterns with 99.7% accuracy and predicts potential accumulation zones based on environmental conditions.

[0007] Avoidance Mechanisms

Upon detecting ice risk conditions, the system:

a) Modifies robot movement patterns to reduce exposure to high-risk zones

b) Adjusts component operating temperatures through localized heating elements

c) Reroutes navigation paths to avoid areas of confirmed ice accumulation

d) Initiates automated deicing procedures when necessary

CLAIMS

A system for ice detection and avoidance in autonomous mobile robots comprising:

a) A distributed sensor network for monitoring environmental conditions

b) Thermal imaging arrays for ice formation detection

c) A central processing unit executing proprietary ice detection algorithms

d) Adaptive navigation controls responding to detected ice conditions

The system of claim 1, wherein the sensor network includes:

a) Temperature sensors accurate to 0.1 C

b) Humidity sensors with 1% accuracy

c) Infrared imaging modules with 640x480 resolution

d) Vibration sensors for detecting ice-induced mechanical changes

The system of claim 1, wherein the ice detection algorithms:

a) Process real-time sensor data

b) Generate ice formation risk maps

c) Predict potential ice accumulation patterns

d) Trigger automated response protocols

DRAWINGS

[Figure descriptions and references omitted for brevity]

INVENTORS

Dr. Elena Frost

Marcus Chen

Dr. James Barrett

ASSIGNEE

Polar Dynamics Robotics, Inc.

1000 Arctic Way

Dover, Delaware 19901

ATTORNEY OF RECORD

Katherine P. Thompson

Registration No. 58,421

Arctic IP Law Group LLP

100 Frost Street, Suite 500

Boston, MA 02110

CERTIFICATION

I hereby certify that this patent document and all statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true; and further that

these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under Section 1001 of Title 18 of the United States Code.

/s/ Katherine P. Thompson

Registration No. 58,421

Date: January 11, 2022