PATENT APPLICATION

Autonomous Ice Thickness Assessment System

Patent Application No. 16/789,432

Filing Date: March 15, 2023

ABSTRACT

An autonomous system for real-time assessment of ice accumulation thickness on surfaces in cold environment operations, comprising multiple sensor arrays, thermal imaging capabilities, and machine learning algorithms for precise measurement and analysis of ice formation patterns. The system enables autonomous mobile robots to safely navigate and operate in sub-zero environments while monitoring and responding to ice-related hazards.

BACKGROUND OF THE INVENTION

[0001] In cold storage and industrial freezer environments, ice accumulation presents significant challenges for autonomous mobile robot (AMR) operations. Traditional methods of ice detection and thickness measurement rely on manual inspection or simple sensors that cannot provide comprehensive, real-time data needed for safe autonomous navigation.

[0002] Existing solutions fail to account for variable ice formation patterns, surface temperature differentials, and the dynamic nature of industrial cold storage environments. This invention addresses these limitations through an integrated system of advanced sensors and artificial intelligence.

SUMMARY OF THE INVENTION

[0003] The present invention provides an autonomous ice thickness assessment system comprising:

- Multi-spectral imaging arrays

- Thermal conductivity sensors

- Machine learning processors

- Environmental condition monitors

- Real-time data analysis algorithms

[0004] The system enables autonomous robots to:

(a) Detect ice formation in real-time

(b) Measure ice thickness with sub-millimeter accuracy

(c) Map ice distribution patterns

(d) Predict potential hazard zones

(e) Adjust navigation parameters accordingly

DETAILED DESCRIPTION

[0005] The primary components of the system include:

Sensor Array Configuration

[0006] The invention utilizes a distributed network of sensors including:

- Infrared thermal imaging cameras (Resolution: 640x512 pixels)

- Ultrasonic thickness gauges (Accuracy: 0.1mm)

- Capacitive ice sensors

- Temperature and humidity sensors

Processing Unit

[0007] A dedicated processing unit employing:

- Custom neural network architecture

- Real-time data fusion algorithms

- Environmental condition correlation

- Predictive analytics engine

Navigation Integration

[0008] The system interfaces with the robot's navigation systems through:

- API-level integration with motion planning

- Dynamic path adjustment protocols

- Safety override capabilities

- Hazard avoidance algorithms

CLAIMS

An autonomous ice thickness assessment system comprising:

(a) A plurality of sensor arrays mounted on an autonomous mobile robot

(b) A processing unit configured to analyze sensor data

(c) Machine learning algorithms for ice pattern recognition

(d) Navigation system integration protocols

The system of claim 1, wherein the sensor arrays include:

(a) Thermal imaging cameras

(b) Ultrasonic thickness gauges

(c) Capacitive ice sensors

(d) Environmental condition monitors

The system of claim 1, further comprising:

(a) Real-time data analysis capabilities

(b) Predictive hazard mapping

(c) Dynamic navigation adjustment protocols

DRAWINGS

[0009] Figure 1: System Architecture Diagram

[0010] Figure 2: Sensor Array Configuration

[0011] Figure 3: Data Processing Flow

[0012] Figure 4: Navigation Integration Schema

INVENTORS

Primary Inventor: Dr. James Barrett

Secondary Inventors: Marcus Chen, Dr. Elena Frost

Assignee: Polar Dynamics Robotics, Inc.

ATTORNEY INFORMATION

Patent Attorney: Sarah J. Thompson

Registration No.: 58,943

Law Firm: Thompson & Associates LLP

Address: 1234 Technology Drive, Suite 500

Boston, MA 02110

DECLARATION

I hereby declare that 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.

Executed on: March 15, 2023

/s/ Dr. James Barrett

Dr. James Barrett

Chief Robotics Officer

Polar Dynamics Robotics, Inc.