PATENT SPECIFICATION

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COLD-ENVIRONMENT SAFETY PROTOCOLS FOR

Patent No. PDR-2021-0147

ABSTRACT

A system and method for implementing safety protocols in autonomou
robots operating in extreme cold environments, comprising temperatu
sensors, redundant navigation systems, and adaptive safety algorithm
specifically designed for sub-zero conditions between -40 C and 0 C.

BACKGROUND

[0001] Autonomous mobile robots operating in cold storage and freez environments face unique challenges related to safety, navigation, an mechanical operation. Traditional safety protocols become unreliable exposed to extreme cold conditions, creating potential hazards for bot equipment and personnel.

[0002] Existing solutions fail to adequately address the specific safety requirements of robots operating in sustained sub-zero temperatures, particularly regarding sensor reliability, emergency stop mechanisms, human-robot interaction protocols.

SUMMARY OF THE INVENTION

[0003] The present invention provides a comprehensive safety protoc

autonomous mobile robots operating in cold environments, incorporat

a) Temperature-compensated safety sensors utilizing proprietary Blue
technology

b) Redundant emergency stop mechanisms rated for operation at -40

c) Adaptive proximity detection algorithms accounting for condensatio
formation

d) Multi-layer safety zone management system with cold-specific para

e) Fail-safe protocols designed specifically for low-temperature enviro

DETAILED DESCRIPTION

Section 1: System Architecture

[0004] The safety protocol system comprises:

1 Primary Control Unit

- Thermally-insulated processing module
- Cold-resistant circuit boards with operating range -40 C to +25 C
- Redundant power supply with cold-weather rating

2 Sensor Array

- Minimum of four temperature-hardened LiDAR sensors
- Dual-redundant infrared proximity detectors
- Ultrasonic sensors with ice-detection capability

Pressure-sensitive bumper system with cold-resistant materials

Section 2: Safety Zone Implementation

[0005] The system establishes three distinct safety zones:

1 Critical Zone (0-0.5 meters)

- Immediate stop activation
- Emergency signal broadcast
- Personnel alert system engagement

2 Warning Zone (0.5-2.0 meters)

Speed reduction protocol

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Enhanced scanning frequency

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Acoustic warning signals

3 Monitoring Zone (2.0-5.0 meters)

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Standard operational protocols

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Environmental condition monitoring

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Traffic pattern analysis

Section 3: Emergency Response Protocols

[0006] The system implements:

1 Temperature-Specific Emergency Procedures

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Graduated response based on temperature conditions

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Automatic shutdown at -45 C or below

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Emergency heat generation for critical components

2 Personnel Safety Features

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Anti-slip path projection system

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Condensation management protocols

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Ice formation detection and avoidance

CLAIMS

A method for implementing safety protocols in cold-environment autor

a) Continuous monitoring of environmental temperature conditions

b) Adaptive adjustment of safety parameters based on temperature

c) Implementation of redundant emergency stop mechanisms

d) Dynamic modification of navigation parameters in response to dete formation

The method of claim 1, further comprising:

a) Real-time adjustment of sensor sensitivity based on temperature

b) Automatic modification of safety zone parameters in extreme cold c

c) Implementation of personnel detection protocols specific to cold-we

DRAWINGS

[Reference is made to accompanying drawings PDR-2021-0147-D1 th

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CERTIFICATION

I hereby certify that this patent application accurately represents the invention as developed by Polar Dynamics Robotics, Inc., and contain prior art conflicts as of the filing date.

/Sarah J. Thompson/

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