PATENT SPECIFICATION

Arctic-Grade Vision System for Autonomous Mobile Robots

Patent No. PDR-2021-0147

ABSTRACT

A vision system for autonomous mobile robots operating in extreme cold environments, comprising temperature-hardened optical sensors, an integrated thermal management subsystem, and proprietary image processing algorithms designed to maintain reliable object detection and navigation capabilities in temperatures ranging from -40 C to +25 C.

BACKGROUND OF THE INVENTION

[001] Autonomous mobile robots (AMRs) operating in cold storage and industrial freezer environments face significant challenges related to sensor reliability and vision system performance. Conventional vision systems experience degraded performance or complete failure in sub-zero temperatures due to lens fogging, sensor malfunction, and compromised image processing capabilities.

[002] Traditional solutions have failed to address the comprehensive requirements for reliable vision system operation in extreme cold environments, particularly in maintaining consistent object detection and navigation accuracy below -30 C.

SUMMARY OF THE INVENTION

[003] The present invention provides a cold-resistant vision system comprising:

- Temperature-hardened optical sensor arrays with integrated heating elements
- Multi-spectrum imaging capabilities including visible light and infrared
- Proprietary anti-fogging lens coating technology
- Thermally-isolated processing units with active temperature management
- Advanced image processing algorithms optimized for cold environment operation

DETAILED DESCRIPTION

Thermal Management Subsystem

[004] The vision system incorporates a novel thermal management approach utilizing:

- Micro-heating elements embedded within sensor housings
- Thermally-conductive pathways for heat distribution
- Temperature-sensing feedback loops
- Active thermal regulation controls

[005] The thermal management subsystem maintains optimal operating temperature for all critical components while minimizing power consumption through intelligent heat distribution algorithms.

Optical System Architecture

[006] The optical system comprises:

- Primary wide-angle camera array (120 field of view)
- Secondary narrow-field high-resolution cameras
- Infrared depth sensors
- Proprietary lens coating resistant to -40 C
- Heated optical pathways preventing condensation

[007] Sensor arrays are arranged in redundant configurations ensuring system reliability even if individual components experience temporary impairment.

Image Processing Algorithms

[008] The system employs proprietary algorithms for:

- Real-time image stabilization in cold conditions
- Environmental feature extraction optimized for low-contrast scenarios
- Object detection and classification using temperature-adjusted parameters
- Navigation path planning accounting for cold-weather variables

CLAIMS

A vision system for autonomous mobile robots comprising:

a) Temperature-hardened optical sensors capable of operation between -40 C and +25 C

b) Integrated thermal management subsystem

c) Anti-fogging lens coating technology

d) Cold-optimized image processing algorithms

The vision system of claim 1, wherein the thermal management subsystem includes:

a) Micro-heating elements

b) Temperature sensors

c) Active thermal regulation controls

The vision system of claim 1, wherein the optical system includes:

a) Multiple camera arrays with redundant coverage

b) Infrared depth sensing capabilities

c) Heated optical pathways

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LEGAL REPRESENTATION

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CERTIFICATION

I hereby certify that this patent application accurately describes the Arctic-Grade Vision System invention and 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.

Executed this 15th day of March, 2021

/s/ Dr. Elena Frost

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PATENT OFFICE ANNOTATIONS

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[END OF PATENT SPECIFICATION]