PATENT SPECIFICATION

United States Patent Application No. 16/789,432

Title: SUB-ZERO VISION SYSTEM WITH DEFOG TECHNOLOGY FOR AUTONOMOUS MOBILE ROBOTS

Applicant: Polar Dynamics Robotics, Inc.

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ABSTRACT

A vision system for autonomous mobile robots operating in sub-zero environments, comprising an integrated defog technology that maintains clear optical pathways in extreme cold conditions. The system includes a thermally-regulated camera housing, multi-layer anti-condensation coating, and an active defog control system that prevents ice formation and maintains optimal visibility for robot navigation in temperatures as low as -40 C.

BACKGROUND OF THE INVENTION

[0001] Autonomous mobile robots operating in cold storage environments face significant challenges related to sensor visibility and performance degradation due to condensation, frost formation, and thermal stress. Existing solutions fail to adequately address these issues, particularly in industrial freezer environments where temperatures can reach -40 C or lower.

[0002] Traditional defog systems rely on heating elements that consume excessive power and can create thermal gradients that affect sensor accuracy. Furthermore, existing anti-fog coatings lose effectiveness at extreme low temperatures, compromising robot navigation and safety systems.

SUMMARY OF THE INVENTION

[0003] The present invention provides a novel vision system specifically designed for autonomous mobile robots operating in sub-zero environments. The system comprises:

a) A thermally-isolated camera housing with multi-zone temperature regulation

b) A proprietary anti-condensation coating system utilizing nano-scale hydrophobic materials

c) An active defog control system that modulates thermal elements based on environmental

conditions

d) Integrated environmental sensors for predictive fog prevention

e) A machine learning algorithm that optimizes defog operations based on operating conditions

DETAILED DESCRIPTION

[0004] The vision system housing (100) comprises:

- Outer shell (101) constructed of thermal-resistant composite material
- Inner chamber (102) with precision temperature control
- Optical pathway (103) with multi-layer anti-condensation coating
- Thermal regulation system (104) with distributed heating elements
- Environmental sensor array (105) for condition monitoring

[0005] The anti-condensation coating system includes:

- Base layer (201) of thermally-conductive material
- Hydrophobic nano-coating (202) with self-cleaning properties
- Protective outer layer (203) resistant to extreme temperatures
- Bonding interface (204) designed for thermal cycling stability

[0006] The active defog control system comprises:

- Microprocessor control unit (301)
- Temperature sensor array (302)
- Humidity sensors (303)
- Power management system (304)
- Machine learning module (305)

CLAIMS

A vision system for autonomous mobile robots comprising:

a) A thermally-regulated camera housing;

b) An anti-condensation coating system;

c) An active defog control system;

wherein said system maintains clear optical pathways in environments between 25 C and -40 C.

The vision system of claim 1, wherein the anti-condensation coating comprises multiple layers of hydrophobic materials optimized for sub-zero operation.

The vision system of claim 1, further comprising a machine learning system that optimizes defog operations based on environmental conditions.

[Claims 4-20 continued...]

DRAWINGS

[Figure descriptions and technical drawings would be included here]

DECLARATION

I hereby declare that:

(i) I am the original inventor of the subject matter which is claimed and for which a patent is sought;

(ii) I have reviewed and understand the contents of the above-identified specification;

(iii) I acknowledge the duty to disclose information which is material to patentability as defined in 37 CFR 1.56.

Executed on: March 15, 2023

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POWER OF ATTORNEY

The undersigned hereby appoints the practitioners associated with Customer Number 12345 to prosecute this application and transact all business in the Patent and Trademark Office connected therewith.

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Date: March 15, 2023