ANTI-FREEZE MECHANISM PATENT FOR EXTERNAL SENSORS

PATENT SPECIFICATION

ANTI-FREEZE MECHANISM FOR EXTERNAL ROB

Patent Application No. 16/789,432

TECHNICAL FIELD

[0001] The present invention relates generally to robotic sensor systems, and more particularly to an anti-freeze mechanism for protecting and maintaining operational capability of external sensors in sub-zero temperature environme

BACKGROUND

[0002] Autonomous mobile robots operating in cold storage and freezer environments face significant challenges related to sensor functionality and reliability. Conventional sensor systems are prone to frost accumulation, condensation buildup, and mechanical failure when exposed to sustained sub temperatures.

[0003] Prior attempts to address these challenges have relied primarily on heating elements that consume significant power and reduce overall system efficiency. There remains a need for an energy-efficient solution that maintai sensor operational capability in extreme cold conditions.

SUMMARY OF THE INVENTION

[0004] The present invention provides an anti-freeze mechanism for external

robotic sensors comprising:

- A nano-textured hydrophobic coating system
- A thermally-isolated sensor mounting assembly
- A condensation management channel network
- An integrated defrost cycling system

[0005] The mechanism enables reliable sensor operation in environments ran from -40°C to +25°C while consuming less than 2W of power during standar operation.

DETAILED DESCRIPTION

[0006] Referring to Figure 1, the anti-freeze mechanism (100) includes:

[0007] A sensor housing assembly (110) formed of thermal composite mater

comprising:

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An outer shell (112) with nano-textured hydrophobic coating

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An inner isolation chamber (114)

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Thermal break zones (116)

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Condensation collection channels (118)

[0008] A sensor mounting system (120) comprising:

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Vibration-dampening mounts (122)

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Thermal isolation spacers (124)

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Flexible sensor cable pass-through (126)

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Quick-release mechanism (128)

[0009] An active management system (130) comprising:

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Temperature sensors (132)

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Humidity sensors (134)

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Microprocessor control unit (136)

Defrost activation system (138)

PREFERRED EMBODIMENT

[0010] In the preferred embodiment, the nano-textured coating comprises:

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Base layer: Modified fluoropolymer matrix

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Active layer: Hydrophobic silica nanoparticles

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Top layer: UV-cured protective coating

[0011] The thermal isolation system maintains a temperature differential of u

to 45°C between the sensor and ambient environment while limiting power

consumption to 1.8W during standard operation.

CLAIMS

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An anti-freeze mechanism for external robotic sensors comprising:

a) A thermally-isolated sensor housing assembly

b) A nano-textured hydrophobic coating system

c) An active condensation management system

d) A microprocessor-controlled defrost cycling system

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The mechanism of claim 1 wherein the hydrophobic coating system compris

a) A fluoropolymer base matrix

b) Silica nanoparticles

c) A protective top coating

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The mechanism of claim 1 wherein the condensation management system inc

a) Channeled collection pathways

b) Thermal break zones

c) Automated drainage control

ABSTRACT

An anti-freeze mechanism for external robotic sensors operating in sub-zero environments is disclosed. The mechanism comprises a thermally-isolated se housing with nano-textured hydrophobic coating, integrated condensation management, and microprocessor-controlled defrost cycling. The system ma sensor operational capability in environments from -40°C to +25°C while

consuming less than 2W of power.

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CERTIFICATION

I hereby certify that this patent application accurately describes the invention and meets all requirements for patent submission under 35 U.S.C. §112.

/Elizabeth Morgan/

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