

LOW-TEMPERATURE SENSOR CALIBRATION PATENT

PATENT SPECIFICATION

UNITED STATES PATENT APPLICATION NO. 16/78

Title: SYSTEM AND METHOD FOR LOW-TEMPERATURE SENSOR

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ABSTRACT

A system and method for calibrating sensors in autonomous mobile robots operating in sub-zero environments. The invention comprises a novel temperature compensation algorithm and hardware configuration that maintains sensor accuracy in environments ranging from -40°C to $+25^{\circ}\text{C}$. The system utilizes a multi-layered feedback mechanism incorporating thermal isolation chambers, precision temperature monitoring, and dynamic recalibration protocols.

BACKGROUND OF THE INVENTION

[0001] Autonomous mobile robots operating in cold storage environments face significant challenges related to sensor accuracy and reliability. Traditional sensor calibration methods become unreliable at temperatures below -10°C due to thermal drift and component stress.

[0002] Existing solutions fail to address the compound effects of rapid temperature transitions and prolonged exposure to sub-zero conditions on sensor

performance.

SUMMARY OF THE INVENTION

[0003] The present invention provides a system for maintaining sensor calibration accuracy in extreme cold environments through:

- a) A thermally isolated sensor housing with active temperature control
- b) Real-time temperature compensation algorithms
- c) Automated recalibration protocols triggered by environmental conditions
- d) Redundant sensor arrays with cross-validation capabilities

DETAILED DESCRIPTION

Thermal Isolation System

[0004] The invention employs a multi-layer thermal isolation chamber comprising

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Vacuum-sealed housing with aerogel insulation

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Thermoelectric cooling elements

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Precision temperature monitoring array

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Active thermal management system

[0005] The thermal isolation system maintains sensor components within $\pm 2^\circ\text{C}$ of optimal operating temperature while external environments fluctuate between -40°C and $+25^\circ\text{C}$.

Calibration Algorithm

[0006] The calibration system processes sensor data through:

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Initial baseline calibration at 20°C

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Temperature-dependent correction factors

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Dynamic drift compensation

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Cross-validation against redundant sensors

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Automated recalibration triggers

[0007] The algorithm applies correction factors based on:

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Ambient temperature

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Rate of temperature change

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Duration of cold exposure

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Sensor age and usage history

Hardware Implementation

[0008] The system comprises:

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Primary sensor array

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Secondary validation sensors

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Thermal monitoring system

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Processing unit with dedicated calibration processor

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Environmental condition monitors

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Power management system

CLAIMS

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A system for maintaining sensor calibration in cold environments, comprising

a) A thermally isolated sensor housing

b) Temperature compensation algorithms

c) Automated recalibration protocols

d) Redundant sensor arrays

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The system of claim 1, wherein the thermal isolation maintains sensor temperature

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The system of claim 1, wherein the compensation algorithms account for ambient

DRAWINGS

[0009] FIG. 1 illustrates the thermal isolation chamber design

[0010] FIG. 2 shows the sensor array configuration

[0011] FIG. 3 depicts the calibration system architecture

[0012] FIG. 4 presents temperature compensation data flows

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 both, under Section 1001 of Title 18 of the United States Code.

Signed this 15th day of March, 2023

/s/ Elena Frost, Ph.D.

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PATENT ATTORNEY CERTIFICATION

I hereby certify that this patent application meets all requirements for filing under 35 U.S.C. § 111(a).

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