

## **PATENT SPECIFICATION**

### **PATENT SPECIFICATION**

### **BLUECORE(TM) DEFROST MECHANISM PATENT**

**United States Patent No. 11,847,392**

**Filed: June 15, 2019**

**Issued: September 23, 2021**

### **ABSTRACT**

A system and method for preventing and removing frost accumulation

mobile robots operating in sub-zero environments. The invention comprises a multi-layer thermal management system utilizing proprietary defrost cycles, specialized coating materials, and intelligent thermal sensors to maintain optimal operating conditions for robotic components in extreme cold environments between -40 C and 0 C.

## **BACKGROUND OF INVENTION**

[0001] Autonomous mobile robots operating in cold storage and freezing environments face significant challenges related to frost accumulation and mechanical failure. Traditional defrost mechanisms are inadequate for maintaining consistent operation in sub-zero conditions, particularly when robots must operate continuously for extended periods.

[0002] Prior art solutions have failed to address the unique challenges of frost prevention in mobile robotics, including power consumption constraints

limitations, and the need for continuous operation without manual intervention.

## **SUMMARY OF INVENTION**

[0003] The present invention provides a novel defrost mechanism specifically designed for autonomous mobile robots operating in extreme cold environments. The BlueCore(TM) system comprises:

- a) An intelligent thermal management controller
- b) Network of distributed micro-heating elements
- c) Proprietary hydrophobic surface coating
- d) Advanced frost detection sensors
- e) Predictive defrost scheduling algorithm

## **DETAILED DESCRIPTION**

## Component Architecture

[0004] The primary thermal management controller (TMC) integrates with the robot's main control system, monitoring environmental conditions through a network of sensors positioned at critical points throughout the chassis.

[0005] Micro-heating elements, measuring 15mm x 15mm, are strategically placed near frost-susceptible components. These elements utilize a proprietary carbon-fiber heating material operating at 24V DC with variable power output between 2-50W.

## Surface Treatment

[0006] The invention incorporates a multi-layer surface treatment composed of:

-

Base layer: Titanium-infused polymer coating (0.2mm)

- - 4 -

Middle layer: Thermally-conductive compound (0.3mm)

-

Outer layer: Hydrophobic nano-coating (0.1mm)

## **Control Algorithm**

[0007] The defrost control algorithm employs machine learning to optimize defrost cycles based on:

-

Ambient temperature

-

Humidity levels

-

Robot operational status

- - 5 -

Historical frost accumulation patterns

-

Power availability

## **CLAIMS**

A defrost system for autonomous mobile robots comprising:

- a) A thermal management controller
- b) Multiple distributed heating elements
- c) Multi-layer surface treatment
- d) Environmental sensors
- e) Predictive control algorithm

The system of claim 1, wherein the thermal management controller op

The system of claim 1, wherein the surface treatment comprises three

## DRAWINGS

[0008] Figure 1: System architecture diagram

[0009] Figure 2: Heating element placement schematic

[0010] Figure 3: Surface treatment layer composition

[0011] Figure 4: Control algorithm flowchart

## INVENTORS

-

Dr. Elena Frost, Ph.D.

-

Marcus Chen

- 7 -

Dr. James Barrett

## **ASSIGNEE**

Polar Dynamics Robotics, Inc.

1250 Innovation Drive

Wilmington, DE 19801

## **PATENT ATTORNEY**

Sarah J. Thompson

Registration No. 58,392

Thompson & Associates LLP



Boston, MA 02110

## **GOVERNMENT RIGHTS**

[0012] This invention was made without government support.

## **FIELD OF INVENTION**

[0013] This invention relates to thermal management systems for autonomous mobile robots, specifically addressing frost prevention and removal in operating environments.

## **PRIOR ART REFERENCES**

-

US Patent 10,234,567

-

US Patent 10,456,789

-

US Patent Application 2018/0123456

-

EP Patent 3,234,567

The foregoing description of various embodiments of the invention has been presented for purposes of illustration and description. It is not intended to be exhaustive or to limit the invention to the precise forms disclosed.

