

FROSTBYTE

Low-power monitoring and emergency heating to prevent frostbite

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Frostbite is devastating and costly. Individuals living in cold climates have up to a 20% lifetime incidence of frostbite. Individuals working in the cold have greater risk, with lifetime incidences up to 44%. Treatment for frostbite is essentially non-existent; upwards of 30% of frostbite cases result in amputation and cost ~\$300,000 per incident. A recent Army survey from 2017 - 2022 claims the branch sees ~400 cases per year, costing ~\$120 million annually in operational costs and medical costs. Frostbite incidences are expected to rise in the coming years given geopolitical tensions and growing interest in arctic resources.

Existing cold-weather gear is ineffective. Once fingers/toes become numb, the line between “cold” and “frostbite” is indiscernible. Wearing warmer gloves/socks helps, but there is an inherent tradeoff between warmth and dexterity, and dexterity is often prioritized for those living, working, and recreating in the cold. Numerous heated gloves exist, but commercial solutions have failed to become staples of cold-weather uniforms because they have limited battery life, are not durable for extended use, and require additional effort by the user (e.g., charging batteries, turning on the heating).

We are developing FrostByte, a lightweight glove liner with temperature monitoring and emergency heating elements that prevent frostbite and preserve dexterity. The University of Utah has awarded us a \$100k to develop a prototype which we have accomplished. FrostByte is innovative because it is designed for maximum compatibility, durability, and longevity. There is no user interface. After the user is notified (to prompt evacuation), heating is activated if/when tissue temperature is at risk of frostbite. Additionally, heating is activated at the minimal amount necessary to prevent frostbite on a digit-by-digit basis. The electronics are entirely passive with low RF interference and EM footprint. This technological innovation allows FrostByte to serve as an emergency backup for months, only needing to be replaced or recharged after use. Emergency heating can last ~1 week to support austere conditions where cold exposure cannot be avoided quickly. Monitoring systems last 2 months on a single, replaceable watch battery.

FrostByte sets the standard for arctic gear. FrostByte is designed to fit under cold-weather uniforms used by the military, utility workers, construction workers, ski patrollers, etc. Integrating within existing cold-weather uniforms supports commercialization and compliance with wearing the glove liner. The unique durability, longevity, and technology of FrostByte will help prevent irreversible damage of frostbite in our soldiers.