## IJARSCT

International Journal of Advanced Research in Science, Communication and Technology



International Open-Access, Double-Blind, Peer-Reviewed, Refereed, Multidisciplinary Online Journal

Volume 5, Issue 5, June 2025



## High Altitude Pulmonary Edema and High Altitude Cerebral Edema Prevention and Detection using IoT

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Abstract: The present study describes the development and validation of an Internet of Things-enabled wearable monitoring device specifically designed for the early detection of high-altitude cerebral edema (HACE) and high-altitude pulmonary edema (HAPE). These potentially life-threatening conditions affect individuals ascending to altitudes above 2,500 meters at rates varying between 0.5% to 2% of the climbing population, with incidence increasing dramatically above 4,000 meters. Our system incorporates three clinically validated biosensors: a single-lead electrocardiogram (ECG) module for cardiac monitoring, a reflectance pulse oximeter for blood oxygen saturation measurement, and a non-contact infrared thermometer for core body temperature assessment. The collected physiological data undergoes real-time processing through a microcontroller-based edge computing platform before wireless transmission to a cloud-based monitoring interface. During controlled testing at simulated altitudes equivalent to 5,500 meters, the system demonstrated 93.7% sensitivity and 96.2% specificity in identifying pre-symptomatic HACE cases, while maintaining a false positive rate below 4.8% for HAPE detection. The complete system package weighs approximately 187 grams and provides continuous monitoring for up to 72 hours on a single battery charge, making it particularly suitable for expedition medical teams and high-altitude rescue operations.

Keywords: high-altitude pulmonary edema

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