Design and Implementation of a Novel Thermographic Device for Rapid Diagnosis of Partial Thickness Burns

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Rapid, accurate, and non-invasive assessment of tissue viability remains a frontier of medical research. For example, a large proportion of burn wounds are those of partial, indeterminate thickness, but diagnostic accuracy is only 50-60% due to difficulty in identifying damage to the underlying dermal vascular plexus. The phenomenon of burn wound further complicates diagnosis. Infrared thermography has been explored as a means of evaluating burns, as wound temperature may reflect local vascular damage. Recently, active dynamic thermography (ADT) has emerged as a more sensitive counterpart to static thermography. ADT uses transient cooling and reheating to derive thermal properties that correlate with burn depth. However, research on ADT as a diagnostic tool is limited. The clinical application of ADT was pioneered in a clinical trial utilizing a cool saline pour during thermal imaging. An ADT metric was developed from this data. This approach was implemented in a thermal imaging device which uses a novel algorithm written in Python to filter noise within ADT time series and analyze the thermal properties of wound reheating on a per-pixel basis, enabling the non-invasive evaluation of burns in real time. Hardware was assembled using an open-source online guide and housed in a custom 3D-printed enclosure. This analysis technique was used to evaluate burns in 98 patients. Results indicated improved sensitivity of the device's algorithm compared to conventional ADT techniques, which allowed for the accurate prediction of wound conversion. Moving forward, this approach will be tested in a larger patient pool with corresponding tissue biopsies to validate results. This approach may be useful for other applications requiring the evaluation of adequate vascular perfusion.

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