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# Findings

The research carried out in this thesis highlights the significant potential of 'Low-Level Laser Therapy (LLLT)' as an effective and adaptable therapeutic modality. A major achievement of the study is the development of a customized LLLT device using an 808 nm laser diode, enabling precise control over frequency, power density, and irradiation time. The incorporation of an AVR-controlled system along with an interactive touchscreen interface allows clinicians to adjust therapy parameters with enhanced accuracy and convenience. This contributes to improved treatment precision and expands the scope of clinical applications across various medical conditions where LLLT has demonstrated benefits.

Alongside hardware development, this study investigated the integration of machine learning techniques to strengthen diagnostic capabilities. A convolutional neural network (CNN) model was developed for the classification of skin lesions, employing Bayesian optimization and data augmentation strategies to improve model performance. High accuracy was achieved in both binary and multiclass classification tasks, demonstrating the strong potential of artificial intelligence to support clinicians through early detection and automated diagnostic assistance, especially in dermatological settings.

Monte Carlo simulations of laser–tissue interactions provided critical insights into light absorption, heat distribution, and photon transport within biological structures. These findings reinforce that accurate adjustment of laser parameters such as wavelength, intensity, and exposure duration is essential for maximizing therapeutic outcomes while minimizing the risk of tissue damage. The results further highlight the importance of fine-tuned LLLT protocols in scenarios involving deeper tissue layers or sensitive anatomical regions.

This work also presents an automated wound classification framework utilizing deep learning and transfer learning methods. The system demonstrated effective performance in identifying major chronic wound types, including diabetic ulcers, venous ulcers, pressure injuries, and surgical wounds. The combination of optical modeling and artificial intelligence lays the foundation for improved wound assessment and personalized treatment planning, bridging the gap between diagnosis and targeted laser therapy.

Additionally, the study explored the potential application of laser-induced thermal therapy in the treatment of brain tumors. Simulation results indicated that precise manipulation of laser power, exposure time, and wavelength selection can create sufficient thermal elevation within tumor regions while preserving surrounding healthy tissue. These findings suggest that laser interventions, when optimized using computational models, may serve as minimally invasive options for cancer treatment in the future.

In summary, the integration of intelligent diagnostic models, computational simulations, and precision-engineered laser hardware demonstrates that LLLT has the capability to evolve into a more personalized and clinically intelligent therapeutic system. The findings indicate that combining artificial intelligence with LLLT enhances treatment effectiveness, ensures safer clinical procedures, and sets the stage for innovative advancements in non-invasive healthcare technologies.