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COMPREHENSIVE REVIEW ON EARLY DETECTION AND CLASSIFICATION OF CERVICAL CELL ABNORMALITIES USING DEEP LEARNING

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Abstract

The review aims to provide an in-depth analysis of the latest deep learning techniques employed in early detection and classification of cervical cell abnormalities in Pap smear images. Cervical cancer is a significant health problem around the world, particularly in developing countries where screening services are scarce. Manual screening methods have been limited in their ability to be scalable, accurate, and sensitive, which has driven the need for automated methods that are

accurate and sensitive. This paper reviews systematically different architectures of deep learning models such as CNN-based models like MobileNet, ResNet, EfficientNet, and hybrid models, which are based on deep feature extraction and machine learning classifiers. The advantages and disadvantages of existing models are pointed out, and the fact that the majority of models used have sacrificed sensitivity for ease of use in clinical practice is emphasized, which may result in the loss of positive cases in clinical practice. In addition, the review covers issues of high computational cost, data imbalance and poor model interpretability, which are important factors to consider when applying the models in the real world, particularly in resource-limited contexts. SHAP and LIME are mentioned as important explainability techniques to improve model transparency and clinical trust. This review summarizes the existing findings and highlights some critical research gaps and directions to move forward, including the creation of lightweight, sensitive, and interpretable deep learning frameworks that can be easily deployed in various clinical settings. The findings shared are meant to inform researchers and clinicians of how to enhance AI-based cervical cancer screening systems which will help to improve global cervical cancer morbidity and mortality outcomes, enhance patient outcomes, and increase earlier detection.

Keywords:

Cervical Cancer Screening, Deep Learning, Pap Smear Image Classification, Explainable Artificial Intelligence (XAI), Cervical Cell Abnormality Detection