

Oral Cancer Detection with Image Processing Using CNN and VGG16

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Abstract: Oral cancer is a major public health concern, particularly in developing countries such as India, where tobacco use, alcohol consumption, and poor oral hygiene contribute to its high incidence. Early detection significantly improves survival rates and reduces treatment complexity, yet diagnosis often occurs at late stages due to limited specialist availability, inconsistent screening practices, and the subtle nature of early lesions. This paper presents a deep learning-based framework for automated oral cancer screening using clinical photographs. Convolutional Neural Networks (CNNs) with transfer learning approaches, including ResNet and EfficientNet, are employed to classify oral images as “suspicious” or “not suspicious.” The system incorporates preprocessing techniques such as resizing, normalization, and device-aware calibration, along with augmentation methods like rotation, flipping, and brightness adjustments to enhance model generalization. Performance is evaluated using clinically relevant metrics, including sensitivity, specificity, precision, F1-score, and ROC-AUC, supported by confusion matrix analysis. To improve transparency, Grad-CAM explainability overlays are generated, enabling clinicians to verify whether predictions align with lesion regions.

The prototype is deployed via a lightweight Flask-based web interface with Docker packaging, making it suitable for pilot trials in low-resource settings. Experimental results demonstrate that the proposed system achieves high sensitivity, ensuring that fewer suspicious cases are missed, while maintaining clinically manageable false positives. By integrating explainability, clinician feedback, and ethical safeguards, this framework provides a reproducible and practical decision-support tool for early oral cancer.

Keywords: Oral Cancer Detection, Deep Learning, Convolutional Neural Networks (CNN), Transfer Learning, ResNet, EfficientNet, Grad-CAM, Explainable AI, Medical Image Analysis, Decision-Support Systems, Healthcare AI, Flask Deployment, Low-Resource Settings.

