CardioViT-CAM: Self-Supervised Vision Transformer with Class Activation Mapping for Interpretable Congenital Heart Disease Detection

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Abstract— Congenital heart disease (CHD) persists as a dominant source of infant disease and demise. Although transthoracic echocardiography (TTE) is essential for screening CHD, expert- level recognition remains limited in many clinical settings. We recommend CardioViT-CAM, a two-stage learning framework that integrates a self-supervised learning method, Mask Autoencoder (MAE) pre-training for feature representation, and supervised vision transformer (ViT-B/16) fine-tuning for automated CHD classification. Our approach leverages 74,000 unlabeled echocardiographic frames for pretraining and 6,000 labelled images for three-class classification (ASD, VSD, AVSD). Grad-Cam++ visualization provides understandable heatmaps that emphasize defects of diagnostic cardiac regions. CardioViT- CAM achieved 97.03% accuracy, 97.04% precision, 97.03% recall, and 97.03% F1-Score, representing strong diagnostic performance and interpretability for clinical decision support.

Keywords— ***Congenital Heart Disease, Echocardiography, Self-Supervised Learning, Vision Transformer, Grad-Cam++.***

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