Clinical Decision Support for Early Diagnosis of Cardiomegaly by Using Deep Learning Techniques on Chest X-rays

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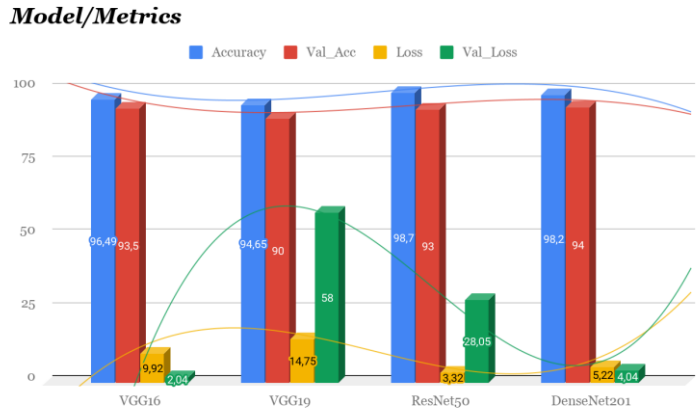
Background: Cardiomegaly is a medical condition where the heart is enlarged, and early detection is crucial for better management. One of the most commonly used diagnostic tools to detect abnormalities in human organs, including cardiomegaly, is chest X-rays. The cardiothoracic ratio (CTR) is an important indicator of an underlying pathological condition, with an abnormal CTR (>0.55) often indicating such a condition. However, even for domain experts, identifying different diseases from X-ray images can be a challenging and time-consuming task.

Materials and Methods: Deep learning models can be effective in such scenarios, but their performance is heavily reliant on large datasets, which are rare in the medical industry due to privacy concerns. To address this issue, we have implemented customized CNN, ResNet-50, VGG16, InceptionV3, and DenseNet-121 models to assist radiologists in diagnosing cardiomegaly and optimizing radiology workflows. Our models were trained on a real dataset called "ChestX-ray8," which included 1012 posteroanterior CXRs from different patients.

Results: Our best model achieved a diagnostic accuracy of 94%, a sensitivity of 96.2%, and a specificity of 92.5%, outperforming prior pre-trained model findings. We also developed a segmentation-based AI model that demonstrated high specificity (>90%) and sensitivity (95%) for CTR calculation. The performance of the radiologists improved significantly when assisted by our AI models.



Conclusion: In summary, our DL-based segmentation model for rapid quantification of CTR can significantly reduce the radiologists' burden and help detect abnormal enlarged hearts early on, making it a valuable tool for clinical workflows.