
**Figure 9** CTR of patient with increased heart

Table 3 Classification Model comparison

| Model | Optimizer | Best Epoch | Test Accuracy | F1-TB | F1-Card |
|---|---|---|---|---|---|
| VGG19 | Adam | 15 | 0.78 | 0.83 | 0.77 |
| DenseNet 201 | SGD | 13 | 0.85 | 0.9 | 0.81 |
| EfficientNetB5 | Adam | 10 | 0.96 | 0.99 | 0.93 |
| EfficientNetB5 | SGD | 4 | 0.963 | 0.99 | 0.94 |
| EfficientNetB5 | R-Adam | 1 | 0.965 | 0.99 | 0.95 |

## 5. Discussions And Conclusions

The objective of this research was to develop a deep convolutional neural network (CNN) model that could accurately distinguish between Tuberculosis and Cardiomegaly diseases using chest X-ray images. To achieve this, we implemented various state-of-art Computer Vision architectures, pre-trained models. Out of the whole lot shown in [Table3], EfficientNetB5 with RAdam optimization demonstrated outstanding results with a remarkable overall accuracy of 97% and F1-scores of 99% for Tuberculosis, 95% for Cardiomegaly, 96% for normal class. Grad CAM technique was implemented to visualize the infected area of the lung. In addition to the objective was to develop a segmentation model to generate the lung and heart masks and later use these masks to confirm if the patient has enlarged heart condition. U-Net with ResNet34 encoder has been used to generate heart and lung masks. The proposed model was able to accurately generate the heart and lung masks with an accuracy of 0.98 for heart and 0.96 for lung portion from chest x-ray. Enlarged heart condition was successfully detected using the masks.

Although most of the targeted goals have been met, there is still scope of improvement of the classification model accuracy and better visualization disease localized areas on the heatmaps.

Future directions of the work include

- Apply data pre-processing techniques such as center crop, resize, enhance the quality of the images by increasing brightness, contrast
- Improve the classification model accuracy using latest deep learning architectures and tuning hyper parameters
- Improve the Visualization of disease localized areas with latest Class activation map methods.

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