

# **A CERTAIN INVESTIGATION ON HEART DISEASES DETECTION SYSTEM USING DEEP LEARNING TECHNIQUES**

## **ABSTRACT**

Cardiac Magnetic Resonance (CMR) Imaging is a successfully used non-invasive imaging technique for diagnosing cardiovascular diseases. CMR is widely used to assess the functionality of left and right ventricular, which discriminates the myocardial structure and changeability. The proposed research work focuses on Deep learning based Left Ventricle (LV) segmentation, as myocardial mass, LV volumes and ejection fraction are the main factors for clinical indices estimation. Deep learning architectures require huge amount of time, expertise and resources. To address this issue, a Convolutional Neural Network (CNN) algorithm combined with edge map and shape feature descriptors is employed here to develop a fully automatic LV segmentation from short-axis cardiac MRI datasets. An improved Fully Convolutional Neural Network (FCN) model based on connected components is proposed here for the automatic LV segmentation. In the First Phase, the proposed Edge and Shape feature based Fully Convolutional Neural Network (ES-FCN) achieves the segmentation from the edge maps of the MRI image rather than using gray-scale image that accelerates the FCN's performance when compared to existing methods. Also, the binary valued kernels are employed for convolution operations, where the binary values are influenced based on biases that are determined based on shape descriptors of the edge map. The ES-FCN learns the bias values from the ground truth segmentation. The

proposed segmentation architecture is evaluated with the short-axis cardiac images received from five different datasets. The proposed ES-FCN model achieves the Jaccard indices of  $0.9484 \pm 0.0188$  for the Automated Cardiac Diagnosis Challenge (ACDC) dataset and  $0.9476 \pm 0.0237$  for the LV Segmentation Challenge (LVSC) dataset, and the dice index of  $0.9319 \pm 0.0188$  for the ACDC dataset and  $0.9314 \pm 0.0237$  for LVSC dataset respectively. The experimental results also reveal that the proposed ES-FCN model is faster and requires minimal resources compared to state-of-the-art models. Comparatively, the ES-FCN is faster and require minimal resources when compare to other state-of-the-art cardiac segmentation methods.

In the Second Phase, a combination of different deep neural networks for semantic segmentation of the left ventricle based on Tri-Convolutional Networks (Tri-ConvNets) to obtain highly accurate segmentation. CMRI images are initially pre-processed to remove noise artefacts and enhance image quality, then ROI-based extraction is done in three stages to accurately identify the LV. The extracted features are given as input to three different deep learning structures for segmenting the LV in an efficient way. The contour edges are processed in the standard ConvNet, the contour points are processed using Fully ConvNet and finally the noise free images are converted into patches to perform pixel-wise operations in ConvNets. The proposed Tri-ConvNets model achieves the Jaccard indices of  $0.9491 \pm 0.0188$  for the sunny brook dataset and  $0.9497 \pm 0.0237$  for

the York dataset, and the dice index of  $0.9419 \pm 0.0178$  for the ACDC dataset and  $0.9414 \pm 0.0247$  for LVSC dataset respectively. The experimental results also reveal that the proposed Tri-ConvNets model is faster and requires minimal resources compared to state-of-the-art models.

Keywords: Deep Learning, Cardiac Magnetic Resonance Imaging,

Left Ventricle, Convolutional Neural Network, Edge and Shape feature based

Fully Convolutional Neural Network, Tri-Convolutional Networks.