Segmentation of the Myocardium on Late-Gadolinium Enhanced MRI based on 2.5 D Residual Squeeze and Excitation Deep Learning Model

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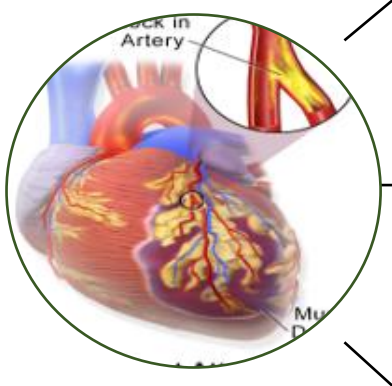
Introduction & Overview
Myocardium and Myocardial Infarction



Introduction

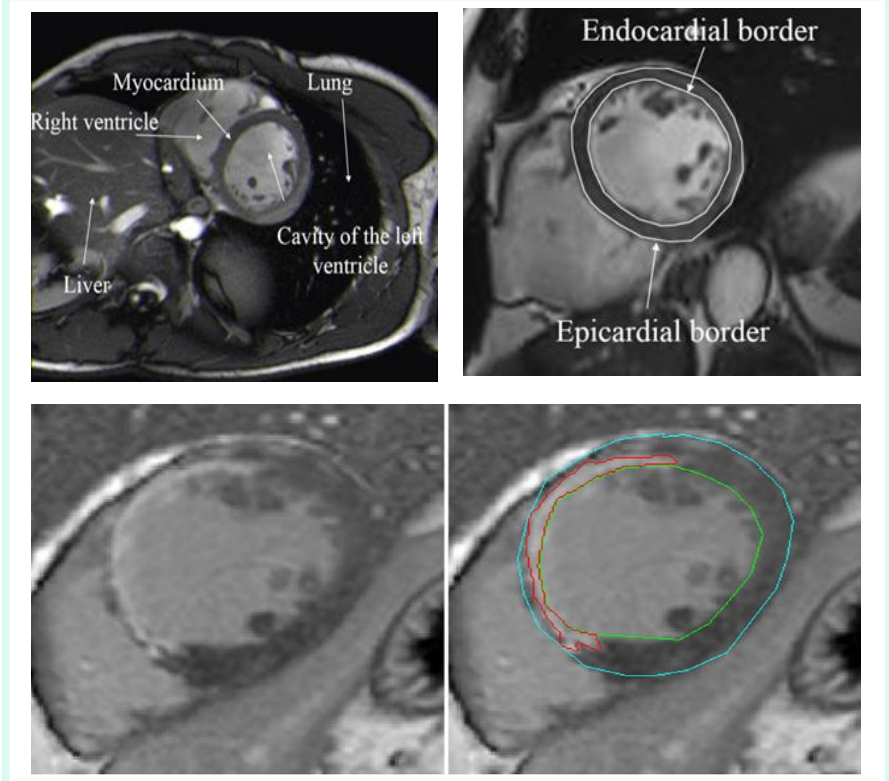
- Myocardial infarction (MI) is an important cause of death worldwide.
- Late gadolinium enhancement (LGE) MRI is highest resolution technique to assess the myocardium and myocardial infarction.

Challenges

- Brightness heterogeneities due to the non-homogeneous
- Partial volume effects
- Inherent noise due to motion artefacts and heart dynamics
- The presence of banding artefact

Solution

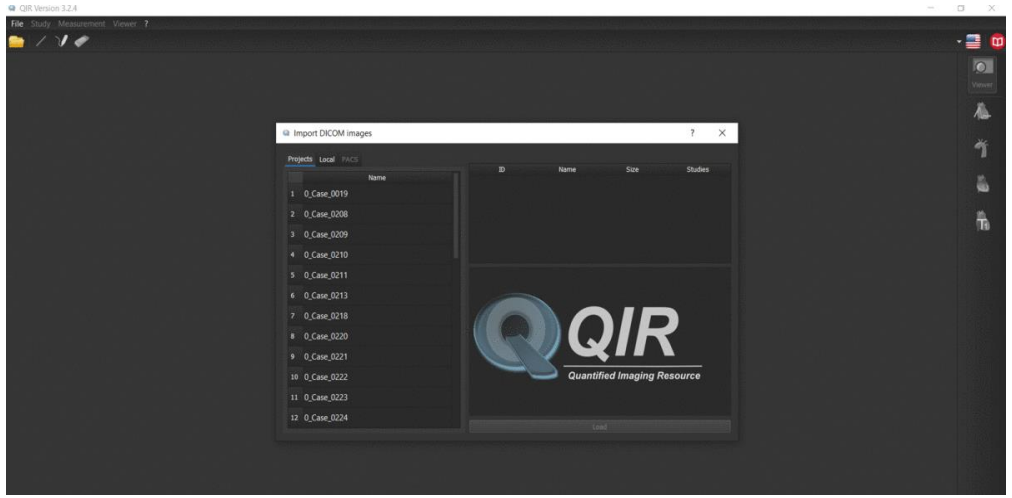
- This work aims to develop an accurate automatic segmentation method based on deep learning models for the myocardial borders on LGE-MRI and evaluation of the extend of the MI need the knowledge of the myocardial borders



Myocardium and myocardial infarction

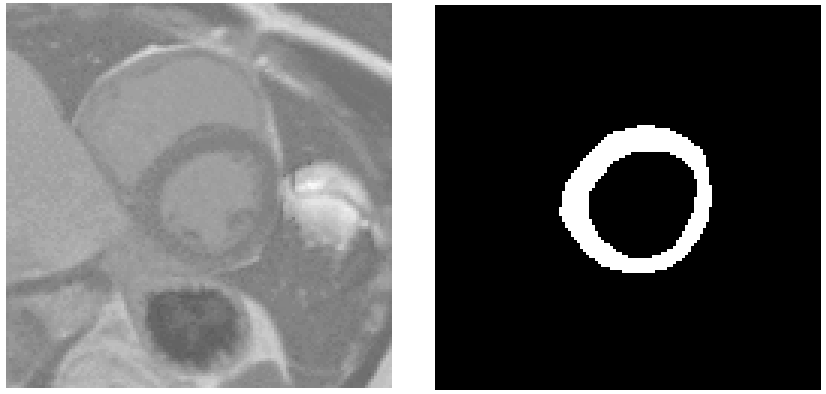
Data Acquisition & Processing

1



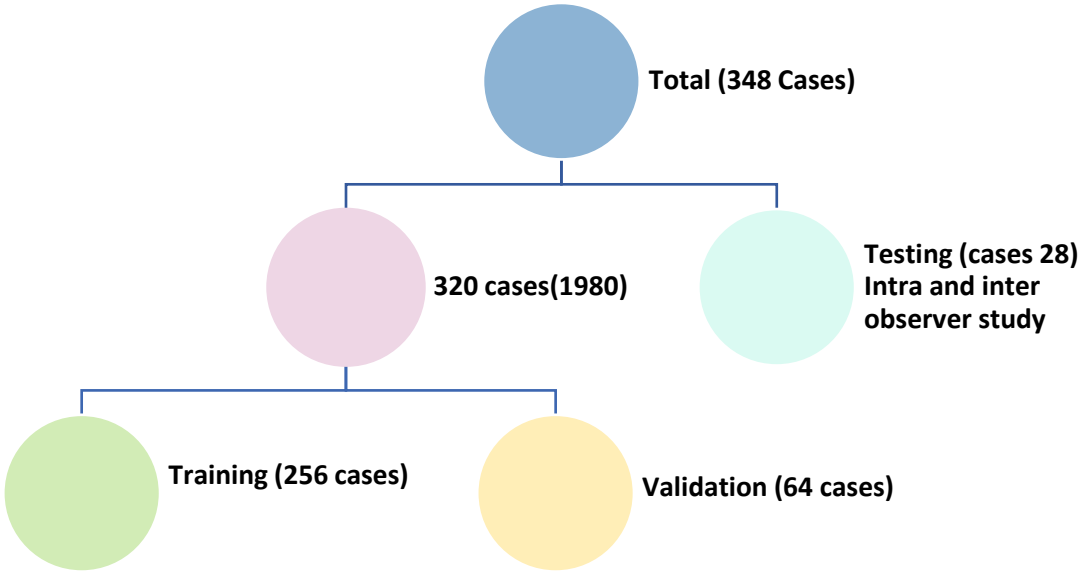
QIR(Quantified Imaging Resource) developed by CASIS (CArdiac Simulation and Imaging Software) company

2



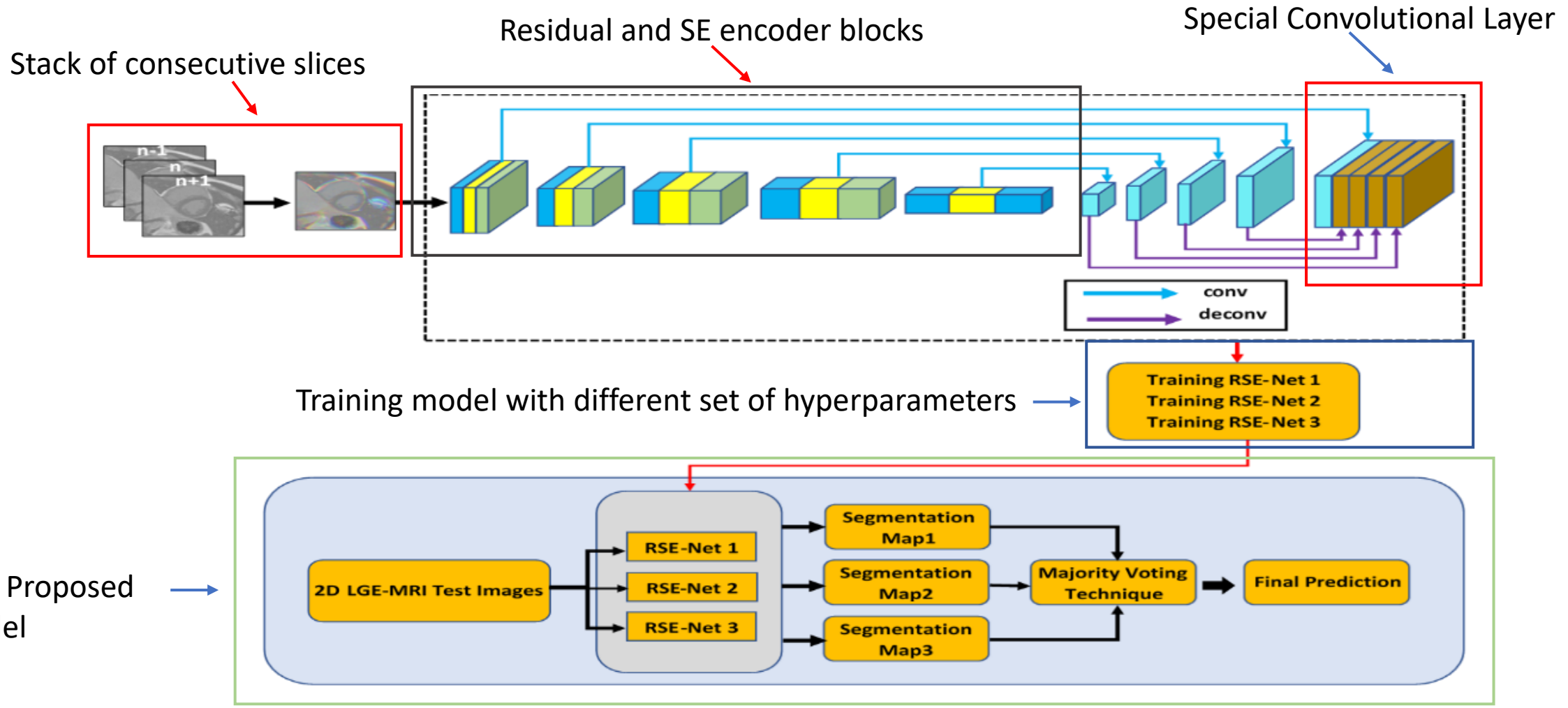
LGE MRI (Left ventricle image Sequences)

3



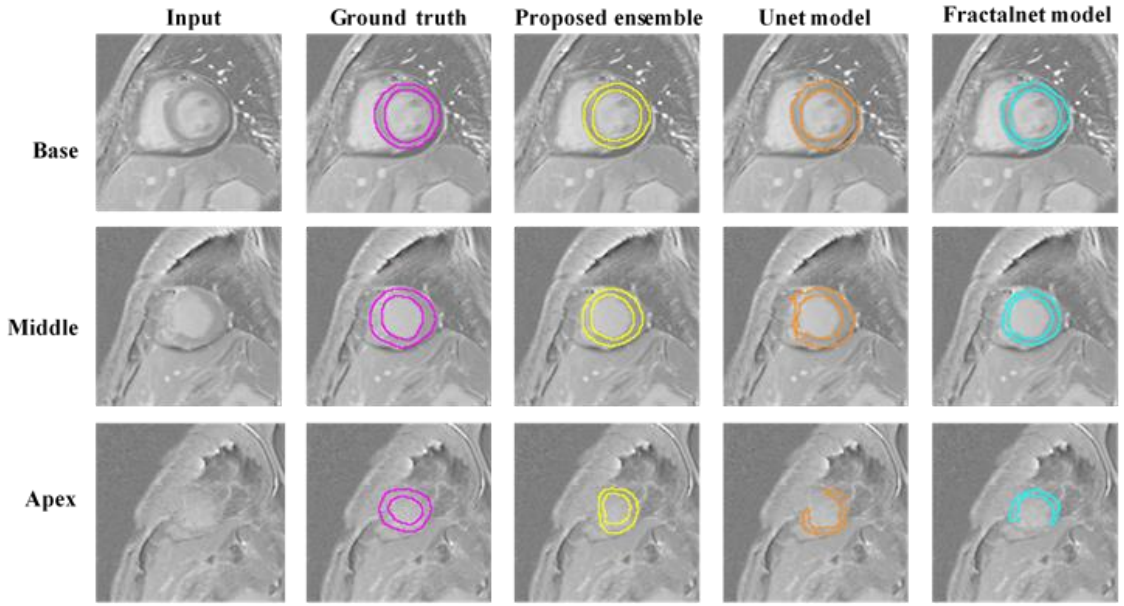
- QIR software used for manual contouring of the myocardial borders (endocardium and epicardium)
- Moreover, intra-observer and inter-observer annotations were provided for the 28 test cases.

2.5D Proposed Segmentation Model



Residual network with special layers and excitation block and ensemble the outputs of model

Experimental Results and conclusion



Segmentation map for proposed and existing deep learning models for base, middle, and apex slices for single patient

Performance evaluation for proposed deep learning model. r represented correlation coefficient and BA is the bland altman

Algorithms		DSC (%)	HD (mm)	*r*	BA Bias (cm2)
Intra-observer variation	Base	86.66	3.01	0.976	0.10(0.50)
	Middle	85.24	2.94	0.961	-0.025(0.33)
	Apex	77.51	2.98	0.941	0.30(1.38)
	Overall	**83.22**	3.26	0.957	0.11 (0.85)
Inter-observer variation	Base	82.54	4.03	0.957	0.34(0.92)
	Middle	81.22	3.87	0.955	0.18(0.73)
	Apex	74.12	3.87	0.924	0.53(1.95)
	Overall	**79.25**	4.12	0.945	0.33 (1.31)
Our Method	Base	86.55	3.13	0.969	-0.16(0.57)
	Middle	84.77	3.65	0.955	0.30(0.87)
	Apex	76.85	3.69	0.930	0.31(1.56)
	Overall	**82.01**	3.67	0.959	0.19 (1.07)

Conclusion

- We have proposed a novel, fully automated ensemble model with 2.5 D strategy for myocardium border segmentation from LGE-MRI images.
- The proposed ensemble method shows excellent results as compared to existing state-of-the art deep learning models and lies with the intra- and inter- observer variabilities.