CVDI Year 7 Mid-Year Report
08/01/18 – 12/31/18

7a.021-TUT-CVDI - Early Detection of Myocardial Infarction Using Echocardiogram Images

Report Date	Project Start	Project End	Project Budget	Amount Spent To Date
14 Jan 2019	1 August 2018	31 July 2019		

PROJECT SUMMARY

The significant proportion (20-30%) of emergency department admissions are related to patients with acute chest pain. In this case, the patients are needed to have a rapid assessment as time-critical treatments may be needed. It has been shown that parameters such as changes in ECG characteristics or alternation of cardiac enzyme/protein may detect only 30% of acute ischemic events. Here, echocardiography can play a valuable role as an alternative diagnostic tool in an appropriate triage of patients with acute chest pain. Echocardiography is a reliable method for revealing the anomalies in the regional heart wall motion. Due to the early manifestation of Myocardial Infarction (MI) symptoms in echocardiogram, this imaging modality is now included in the universal definition of acute MI and in international guidelines regarding the management of cardiac arrest.

In this project, the aim is to design an automatic model, which trace the movement of the heart's wall using the echocardiogram images and detect the anomalies in the wall motion. To be more specific this project is focused on early and accurate detection of the abnormal wall movements in heart associated with the MI.

PROJECT TEAM

Team Member Name	Team Role *(PI, Co-PI, Student, Researcher)*	Academic Site
Moncef Gabbouj	PI	Tampere University
Serkan Kiranyaz	Co-PI	Tampere University
Morteza Zabihi	Researcher	Tampere University
Aysen Degerli	Research Assistant	Tampere University

IAB PROJECT MENTOR(S)

IAB Project Mentor Name	IAB Organization
Matti Vakkuri	Tieto

PROJECT FUNDED BY

IAB Organization(s)
Tieto
Business Finland

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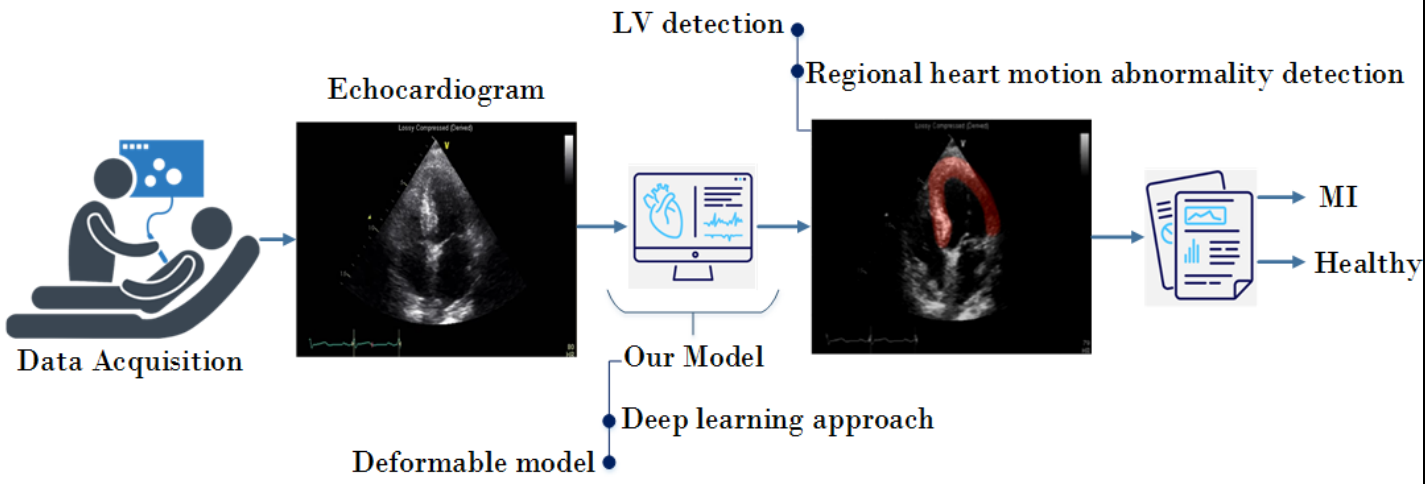
OVERALL PROGRESS/ACHIEVEMENTS TO DATE

In collaboration with CVDI external partners, we gained access to 65 echocardiogram videos with an acceptable quality from healthy subjects and patients with MI. We focus our study on the videos with the 4-chamber view. Based on clinical guidelines for MI detection, we design methods for tracking the heart motion of the left ventricle. Several algorithms (supervised and unsupervised) are being developed for this purpose. We tackle the problem using various approaches so we can have a fair comparison for motion tracking of the heart wall movement. Our ambition is to detect MI in early stages by tracking the wall motion with high accuracy. We started with a well-known CNN architecture for segmentation and extracting the performance of the trained model. We are now experimenting with several parameters settings and study their effect on the accuracy of LV segmentation.



The Block diagram of the proposed approach

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PROJECT DELIVERABLES

Deliverable	Achievements	Remaining To Do
(External) Dataset access and preparation	**80% complete**	May gain access to additional data recording from new patients (~ 40 more videos) + data preprocessing for the new videos
	Gained access to recording echocardiogram from normal and MI subjects (65 subjects)	Quality assessment and evaluating the groundtruth labels by experts
	Creating a standard dataset, i.e., same format, normalization, etc.	Legal requirements and documents, e.g., patient consent forms
Semi-supervised segmentation (using anchor points)	**80% complete**	Improving the robustness of the models (to noise and artifacts)
	Developing and implementing active contour method	Cross-checking the performance of the models with experts
	Merging threshold-based method with active contours to increase the performance of the algorithm	Comparative analysis of the developed methods
Fully automatic segmentation (supervised learning)	**60% complete**	Comparative analysis with state-of-the-art segmentation architectures
	Creating the pseudo-groundtruth for each frame in videos (~2000 frames)	Training using augmentation and/or pre-trained networked
	Designing new deep learning architecture	
Developing an end-to-end model for myocardial infarction detection	**0% complete**	Designing an automatic model to segment the left ventricular wall and detect the anomaly in their movement
	to be done.	