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Survey on Automatic Quality Assessment of Echocardiograms Using Convolutional Neural Networks

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ABSTRACT

Neural network has been evolving day by day with many features. The core of the neural network lies in the interaction between the neurons in the hidden layer. The neurons interact with each other by considering the weights between them. This results in the output of the system. There are many applications in which neural network can be practiced. This paper proposes Convolutional Neural Networks in medical science. It focuses on echocardiography. The term echocardiography means that the internal structure of a patient's heart is studied through the images. The ultrasound waves create these images. The abnormalities in these images are found through echo.

Keywords : Convolutional neural network, Deep learning, Quality assessment, Echocardiography, Apical four-chamber.

I. INTRODUCTION

Data mining has been gaining number of eye consideration in the past decades. Data mining has proved to be very effective in many fields. This paper focuses on a very popular field i.e. healthcare field where data mining has served many applications. One of the applications in healthcare field is predicting the disease through some parameters which will be useful in decision making before diagnosis. This can save a good amount of life since the decision to be taken for diagnosis should be fast. But what if the decision in incorrect and contain some error? This kind of false decision for diagnosis can take a life out of a person. To avoid such kind of risk it is need to make a system which can be reliable and in which the doctor can easily trust. This paper has focused on echocardiography where the decision is to detect the defect in the four chambers of heart quick and this paper proposes Convolutional Neural Network.

II. LITERATURE SURVEY

Lasse Løvstakken and Fredrik Orderud have proposed, a method for the visualization of the effective aperture of phased-array transducers is described. The method operates in real-time during acquisition, and can indicate if a contiguous part of an aperture does not contribute in the image formation. They believe the method can be help ensure that a good image quality is obtained in contexts where the acoustic contact or window is likely to be reduced.

The method is based on the k-space formulation of the ultrasound imaging system, which has proven useful for investigating imaging system performance. [1]

J. H. Park1, S. K. Zhou proposed cardiac view classification of echocardiogram using a fully automatic system . After providing an echo study video sequence, the system provides an output as a view label among the pre-defined standard views. The built system is based on machine learning that extracts knowledge from an annotated database. It provides three features: 1) integrating local as well as global evidence, 2) utilizing view specific knowledge, and 3) employing a multi-class Logit-boost algorithm. In this system, the classification is done on standard cardiac views: apical four chamber and apical two chamber, parasternal long axis and parasternal short axis (at mid cavity). Proposed method helps to achieve a classification accuracy over 96% both of training and test data sets and the system runs in a second in the environment of Pentium 4 PC with 3.4GHz CPU and 1.5G RAM. [2].

Xavier Glorot Antoine Bordes Yoshua Bengio have proposed a technique, that shows rectifying neurons are an even better model of biological neurons and yield equal or better performance than hyperbolic tangent networks ,creating sparse representations with true zeros, which seem remarkably suitable for naturally sparse data. Deep rectifier networks reach their best performance without requirement of any unsupervised pre-training on purely supervised tasks . Hence, these results can be seen as a new milestone in the attempts at understanding the difficulty in training deep but purely supervised neural networks, and closing the performance gap between neural networks learnt with and without unsupervised pre-training. [3] Geoffrey E. Hinton and Vinod Nair have shown how to create a more powerful type of hidden unit for an RBM by tying the weights and biases of an infinite set of binary units, then approximated these stepped sigmoid units with noisy rectified linear units and showed that they work better than binary hidden units for recognizing objects and comparing faces. They also showed that they can deal with large intensity variations much more naturally than binary units. [6]

Sten Roar Snare, Hans Torp, Fredrik Orderud, Bjorn Olav Haugen have proposed a novel method for assisting no expert users in capturing the apical 4-chamber view in echocardiography has been presented. A Wilcoxon signed pair rank test yielded

Sr. No	Publication	Author Name	Paper Name	Year	Objective	Limitation
1.	IEEE	Eva Cavero, A´ lvaro Alesanco, and Jose´ Garc´ıa, *Member, IEEE*	Real-Time Echocardiogram Transmission Protocol Based on Regions and Visualization Modes	2014	Provide system for no expert users in capturing apical 4-chamber views (A4CH) during echocardiography.	Need to improve the detection of foreshortening/oblique cuts.
2	IEEE	Ronak Guptaz Santanu Chaudhuryz Navneeth Subramanian? Satish Govindy z Indian Institute of Technology Delhi, New Delhi, India ? GE Global Research, Bangalore, India y Narayana Institute of Cardiac Sciences, Bangalore, India	ECHOCARDIOGRAM VIEW CLASSIFICATION WITH APPEARANCE AND SPATIAL DISTRIBUTIONS	2015	Provides a single exclusive prediction for each image.	Need to Improve different loss function and used multiple objects per image.

Sr. No	Publication	Author Name	Paper Name	Year	Objective	Limitation
3	IEEE	*R. Mahmood1, T. Syeda-Mahmood2* 1Monta Vista High School, Cupertino 2IBM Research – Almaden, San Jose, CA	Automatic Detection of Left Ventricular Aneurysms in Echocardiograms	2015	Provide strong evidence that dropout is a useful technique for improving neural networks.	Need to improve the quality of features by reducing co-adaptations.
4	IEEE	Beatriz González, Patricia Melin and Fevrier Valdez Tijuana Institute of Technology Tijuana, Mexico	Interval type-2 fuzzy logic gravitational search algorithm for the optimization of modular neural networks in echocardiogram recognition Beatriz	2016	This system Present Caffe, a fully open source framework that affords clear access to deep architectures.	Current system improved by users in speech recognition, robotics, neuroscience, and astronomy.
5	IEEE	Amir H. Abdi, Student Member, IEEE	Automatic Quality Assessment of Echocardiograms Using Convolutional Neural Networks: Feasibility on the Apical Four-chamber View	2017	This paper explores sequential optimization strategies for hyper-parameter optimization for these two datasets	This research would lead to widespread use of echo at any point-of-care

a statistically significant improvement quality. [7]

Sr. No	Publication	Name	Paper	Year	Objective	Limitation
6	IEEE	Deyu Sun, PhD *Philips Research North America* Cambridge, MA, USA	Extracting Key Findings Compared In an Echocardiogram Report	2018	Improve the accuracy by incorporating more search patterns, especially for detecting the statement of current findings written in free text.	Quality of a historical collection of finalized echocardiographic reports.
7	IEEE	Xin Wang Philips Research North America Cambridge, MA	Representation Learning of Finding Codes in Structured Echocardiogram Reporting	2018	accurately detect comparisons in LV size, RV systolic functions, aortic regurgitation, and aortic stenosis (gradient), with 100% of precision, recall, and F-score.	Testing the proposed algorithm on more clinical sites and evaluating a potential mapping strategy between FCs used in different institutes.

III. CONCLUSIONS AND FUTURE WORK

Propose approach provides framework for automatic quality assessment of echo data using deep neural network model. The goal of proposed technique is to improve echo by reducing observer variability in data

acquisition using a real-time feedback mechanism that helps the operator to read just the probe and acquire an optimal echo. By minimizing operator dependency, this research can lead to widespread use of echo at any point-of-care, hence it would enable early diagnosis and treatment of patients having high-risk, with improved accuracy, , quality assurance, workflow, and throughput.

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