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Cardio Vascular Diseases Detection Using Ultrasonic Image by Retaining Deep Learning Model

Damodharan D[1], Amit Kumar Goel[2]

[1]*Research Scholar & Assistant Professor, Department of Computer Science and Engineering, Galgotias University, Uttar Pradesh, India, damodharan@galgotiasuniversity.edu.in*

[2]*Professor, Department of Computer Science and Engineering, Galgotias University, Uttar Pradesh, India, amit.goel@galgotiasuniversity.edu.in*

***Correspondence:** Damodharan D; Email: damodharan@galgotiasuniversity.edu.in; itechdamu@gmail.com

ABSTRACT- Nowadays people are taking more care of their health and lifestyle. At the same time, diseases affected probability also increased even at most one of the deadly diseases is cardiovascular disease. Earlier prediction and diagnosis are the only solution for resolving the issues. To identify deep language models will be used to predict issues efficiently in the earliest stage in the affected location. In this paper, we recommend an Enhanced DCNN model to classify and segment the issue in affected areas using ultrasonic Images. The model has three layers for the primary layer will train the input and passed the hidden layer. The secondary layer will classify the image based on the model and dataset using the convolution layer and finally the affected area presented by the bound box. This model shows the more accurate result on both training and testing data. And this method shows better results with 94% of accuracy are provides while compared to the existing method.

General Terms: Cardio diseases Identification, Model, Medical ultrasonic Pattern Recognition.
Keywords: Classification, Cardiovascular diseases, Deep Learning, Segmentation, Ultrasonic image.

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1. INTRODUCTION

All countries are spent a large amount on health care research and it's related to predicting the diseases in the earlier stage. To identify and create machine language models used to efficiently predict the earliest stage of cardiovascular disease. As a survey and WHO says [1, 2] in the global death rate 17.9 million people are expired every year based on heart diseases. A risk factor also increased day by day based on uncontrolled food habits, large stressful work, hypertension, improper cholesterol level, and not identified the earlier stage of the issues, etc... Even with some of the misclassification of symptoms due to natural hazards, they are not able to know about the CVD diseases sign and symptoms of the disease. Properly identifying and diagnosing is the only solution for this problem.

Nowadays health care field also involves various technologies and converting digitalization like e-health systems, mobile health & monitoring system, medicine online ordering, etc. Due to high costs and fear, normal people will not be ready to take a regular health test [3-5] everyone is affected after only finding the clinic & testing the body. In this ready world different type of disease is affected in people. Like tumors, lung disease, cardiovascular diseases it affects the body with knowing but it will not give time to make decisions based on the various stages. So, if we know earlier, we will give treatment and resolve this problem and improve our health.

AI health care will analyze the problem differently and it will give solutions as all accepted and used for diagnosis. This field is the primary stage analyzing the medical issues, validating & verifying proper data based on the issue methodology will be used to resolve the issues. Especially in Medical techniques machine learning is give more support in the health care system [6, 7]. The resolution of this problem is predicting the earlier stage with help of technology and assisting the treatment. This paper will talk about cardiovascular diseases to identify earlier stages with help of machine learning and Deep Learning. And which techniques are used to predict in earlier stages with less cost and good accuracy level. Most of the applications are used in a manual method for segmentation by an expert is marked the region it's a golden standard. Even the automatic auto segmentation method is faster, cheaper, and also gives more accuracy and reduces the time for reproducible segmentations.

To identify the various support algorithms such as Deep learning algorithms can be taught and proposed implemented to Enhanced Deep CNN, with comparing with other deep learning models like Recurrent Neural Network (RCNN), Multilayer Perceptron, Long Short-Term memory (LSTM), and Sequential Backward Coding.

2. METHOD DISCUSSION

For the implementation we use the data's as non-supervised learning, in this model, we used to give input into two types, the primary one is training purpose and the secondary one is testing purpose both the input are ultrasonic Images based on the image size, range of dataset, only they fixed the ratio to test and train, example (80:20) range. Many of the online supporting applications are used for testing the model with internet dataset sources, like Echo-Net Dynamic, Kaggle (HMC-QU Dataset | Kaggle), and many other sites.

2.1 Data Pre-processing

Data preprocessing is the initial stage for the Deep Learning model. This step is preparing the raw data and changing the format based on the model. From this stage, the input is prepared or changed in a suitable format to pass into the next layer.[8] Using unsupervised data contains a lot of noise mixed so this step is important to finding the missing value, filtering the image noise, removing the label, etc.

2.2 FS-Feature Selection

Feature selection is used to select the feature by a condition from the original feature that is relevant to the application. The algorithms intended for collecting features according to dissimilar evaluation measures fall into three classes: filters, wrappers, and hybrid models [9-11].

During the time of experiments, we only used the covering scheme under the co-lab instrument. To classify the private material to the patient, two attributes are used between the 14 fields compose the dataset: the patient's age and sex [12]. Additionally, more attributes are measured crucial because they encompass important quantifiable records.

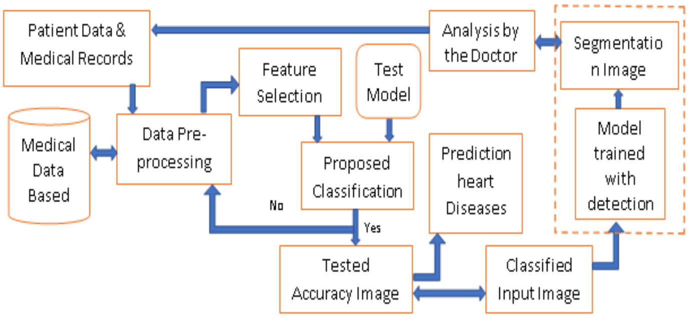

Figure 1: Workflow model diagram with proposed classifications and segments the Image step by step process.

2.3 FE-Feature Extraction

The process of feature extraction involves gathering a subset of attributes from an initial step by revenue means of purposeful planning. The goal of the work was met by using PCA as one of the import records extensively used dimensionality decrease techniques for medical submissions using the python with the co-lab tool, which represents the extracted information into a set of a new variable quantity called mechanisms or features. [13, 14] As a result of PCA, the number of attributes was reduced to 6, which is more conducive to diagnosis.

Test Model is the second stage of the model, it's set of constrain with have testing samples it should be different from the training and validation data. At the same time probability distribution as the same training set. Each testing sample have targets based on the values the model will predict the yi. In this paper primarily focused for classification and segmentation as an Implementation the proposed Enhanced DRCNN model efficiently apply for cardiovascular diseases diagnosis.

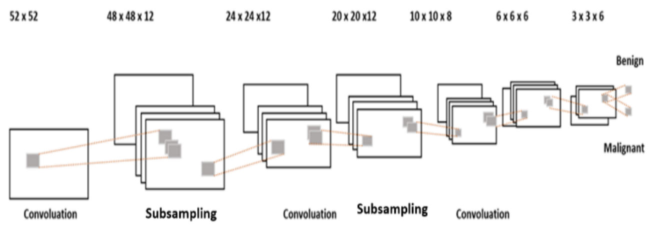

Figure 2: Proposed classification the structure Enhanced Deep CNN Model used in proposed classification

And also compared with other machine learning model such as LR, RF, SVM, Navy Bayes, KNN, and the proposed algorithm, using Python, Co-lab, R-studio, and Jupiter notes tools in this phase. [15,16] As well, machine learning algorithms are also evaluated founded on True Positive-(TP) and True Negative-(TN) values, False Positive-(FP) and False Negative-(FN) [17,29]. Calculating the sensitivity, specificity, precision (Accuracy), and [error rate of an experiment involves these measures. Our goal was to pick the greatest model to accomplish the maximum probable accuracy and allow efficient data classification on medical datasets.

Training samples: 85% of the samples are used to train the model how to correctly classify new samples into the classes you've made.

Test samples: 15% of the samples are always used for training the model, so after the model has been trained on the training sample, they are used to check how well the model is performing on new, never-before-seen data.

Underfit: A model is underfit when it classifies poorly because the model hasn't captured the complexity of the training samples.

Epochs: One epoch means that every training sample has been fed through the model at least once. If your epochs are set to 50 for example, it means that the model you are training will work through the entire training dataset 50 times.

2.4 Convolution

Kernel convolution is a fundamental component of numerous specific Computer Image methods in addition to CNNs. A small number matrix, referred as the kernel or filter, is used in the technique to alter the image based on the values from the filter. [18-21] the input image is represented by the character f and our kernel by the character h in the given equations, which is used to generate subsequent feature map values.

$$G[m,n] = (f * h)[m,n] = \sum_j \sum_k h[j,k] f[m-j, n-k] \quad (1)$$

The rows and columns of the result matrix's indexes are denoted by the numbers m and n, respectively.

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3. RESULT DISCUSSION

As the hardware and software implementation a bordered in this section as well as the details of experiments performed on two separate data sets, namely ultrasonic image analysis and the Echo-Net Dynamic database. We assess the proposed deep learning frameworks for segmentation and classification using the variations in the dataset to determine how well the pre-processing technique operates. The system we evaluated consisted of an Intel Core i5-8th Generation CPU and an NVidia GeForce GTX 1080 Ti GPU. It operated under Windows 10.

Table 1. The performance of Classification Experimental results on proposed model with Another Machine classification model table

Mean and stranded division	RF	LR	SVM	Navy Bayes	KNN	Proposed ensemble
E(%)	7.176	7.716	6.849	7.731	6.787	8.664
Precision(%)	8.25	8.65	8.44	8.336	7.85	9.46
Recall(%)	8.36	8.26	7.53	8.67	7.53	9.28
G-Mean	8.36	8.374	8.55	8.14	7.69	9.265
MC(%)	7.512	6.71	6.269	4.12	8.519	3.591
Specificity(%)	7.85	8.32	7.696	8.281	7.923	8.784
AUC(%)	7.935	8.468	8.526	8.641	7.853	9.267

A final prediction result is generated after taking into account the classifier's arrangement accuracy and misclassification cost (MC). As a convenience measure, we established the cost of accurate classification to zero in command to computation the misclassification costs for dissimilar classifiers. The MC is divided into two scenarios, one for each classifier. Initially, a healthy individual is diagnosed with heart disease, leading to a costly and unnecessary medical treatment. [22, 23] Those with heart disease might be told they are healthy in the second scenario, and thereby miss out on the best opportunity for treatment, which will worsen their condition or even cause them to die [24]. The cost matrix for *table 1* is shown below. To account for the various types of costs people have to bear when misclassification occurs, we set cost1 = 10 and cost2 = 1. Then each classifier is evaluated by constructing the following index:

$$E_i = \frac{Accuracy_{i+1} - \frac{(MC_i)}{cost_1 + cost_2}}{2} \quad (2)$$

Equation: 1 is the performance of an independent classifier, and MC_i is its mean performance throughout the training stage (the method to analyses MC is given in Sect), E_i attitudes for the efficacy of i^{th} classifier.

$$MC = \left(\frac{(FP*cos\,t_2 + FN*cos\,t_1)}{(TP+TN+FP+FN)}\right) * 100\% \quad (3)$$

The *Equation (4)* represented as the Sensitivity (Recall) or True positive rate.

$$TPR = \frac{TP}{(TP+FN)} \quad (4)$$

$$Specificity = \frac{(TN)}{(TN+FP)} \quad (5)$$

$$Accuracy = \frac{(TP+TN)}{(TP+TN+FP+FN)} \quad (6)$$

$$ErrorRate = \frac{(FP+FN)}{(TP+TN+FP+FN)} \quad (7)$$

$$precision = \frac{TP}{TP+FP} \quad (8)$$

$$G - Mean = \sqrt{\frac{TP}{TP+FN} * \frac{TN}{TN+FP}} \quad (9)$$

3.1 Subsections Segmentation Performance

Various experiments are approved out to assess the routine of the future model. *Figure 4*, there is a performance measurement of classification using Accuracy, Recall, F-measure (shows Classification results with emphasis on Recall) besides the segmentation performance is measured using MAP (Mean Average Precision). [25, 26] These equations can be used to compute the metrics. Accuracy is expressed as a percentage of the correctly classified samples in a group of all samples,

$$Accuracy = \frac{\text{Number of classified samples}}{\text{Total samples}} \quad (10)$$

Predictive labels from the area of union overlap in the IOU. Overlapping boundaries are measured by intersection over union. The Predicted Boundary Overlap Ratio (PBOR) measures the probability that the predicted boundary lines up with the object's real boundary.

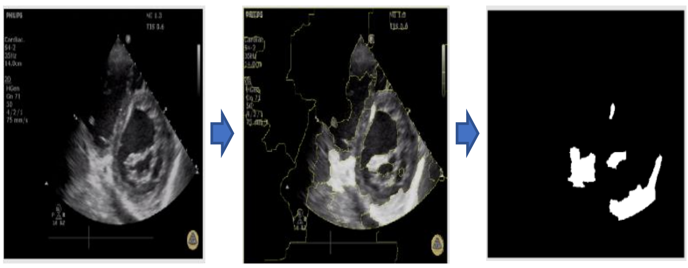
$$IOU = \frac{\text{Area of overlap}}{\text{Area of union}} \quad (11)$$

In segmentation and ROI, normal precision is the average of IOUs measured at unlike scales, which is IOU measured at 0.05 to 0.95.

$$AP = \frac{\sum_{(i=0.05)0.95} IOU(i)}{IOU(s)} \quad (12)$$

Precision averages all precision averages, so precision average is the average of all precision averages,

$$AP = \frac{\text{Sum of all AP0 s}}{\text{Number of AP0 s}} \quad (13)$$



(a) (b) (c)

Figure 3: Segmentation process by step by step to find the affected the area in ultrasonography image.

As showing the above figure, the three images are the step-by-step process for segment the image (a) initial stage for the pre-processing, (b) apply the segmented process and find the ROI and mask the selected area, (c) after masking highlighted the segment region.

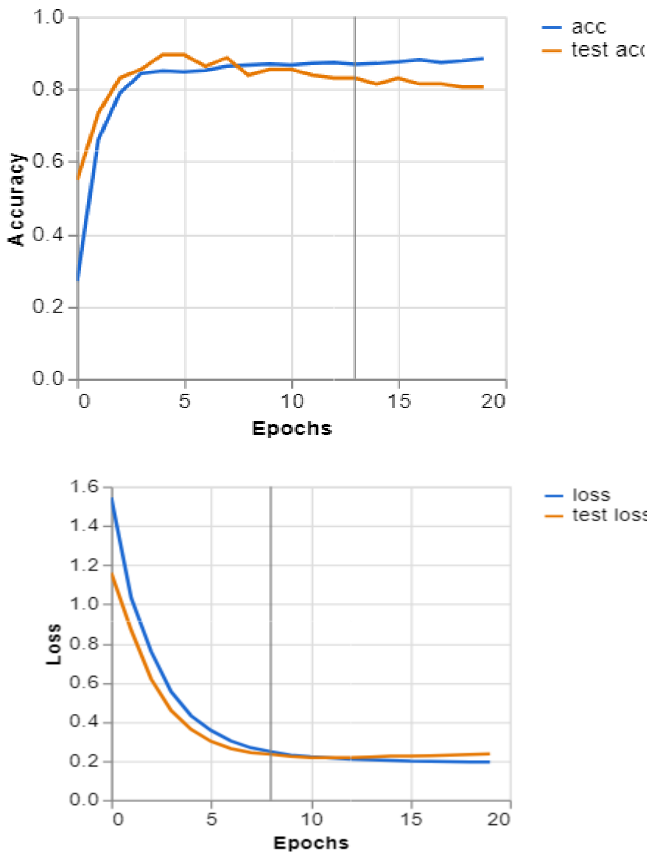


Figure 4: Graph for Test result with epochs based on the test and training accuracy, test and training loss result.

For the implementation 7k sample of data's with different attitude-based value data's taken on the patient. The symptoms and test result analysis the data sets are divided the two parts. That is the training set model and testing model we start to be implementation for our proposed system while make the training 80% of data are second-hand for exercise purpose for training and 20% data are used for verification & validation testing purpose. [27,28] we have compared the various machine learning model are forgetting an accuracy in our proposed method got best accuracy while compared to other model they are got high accuracy at 94.7%

Machine learning algorithms were used to predict heart disease based on the data of each attribute in this study. In our paper, we compared different classification models and identified the most effective. As shown in the below tables, different algorithms performed better depending on the experimental situation such as whether or not cross-validation, calibration, and feature selection were used. [29, 30] With a smaller number of data sets, the proposed performs better than another machine. Performance metrics are used to compare datasets after feature selection, parameter optimization, and calibration since this is a standard evaluation process for algorithms. Table1. Shows the Precision Average Performance of SVM, LR and NB with 85.2%, 85.4% and 7.9% respectively, with the best accuracy without optimization. At the end of the process, we compared each algorithm with the optimized model by the proposed model, and Loss was also lower. All the value in table1 are based on the model Execute output in done in system.

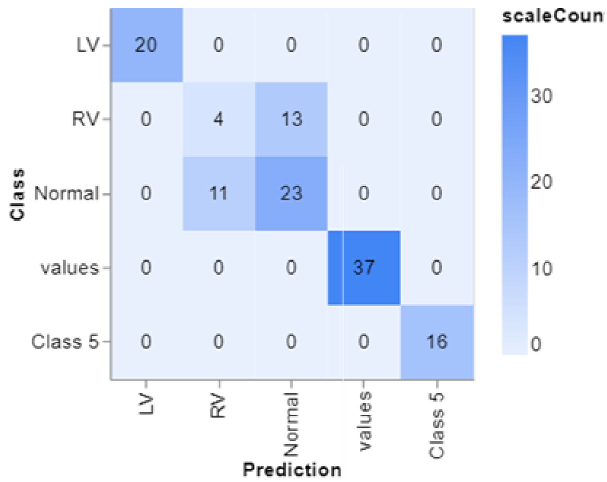


Figure 5: Confusion Matrix for Tested classification value compared with other machine leaning model for prediction & class value in proposed parameter

The confusion matrix represents a useful way to evaluating classification each row and column represent rates in an actual class with showing prediction. There values were fed into proposed model for training data and confusion matrix with labels LV, RV, Normal, Values and Pericardium of the classes' cells respectively. As seen from the confusion matrix the classification gives the best result with the accuracy of 94%.

4. CONCLUSION

In this paper, an improved Deep learning method for Enhanced Deep Convolution neural network with cost-sensitive collaborative technique based on classifiers is employed to contribution in the analysis of coronary artery disease. A new approach to heart disease diagnosis that takes advantage of misclassification costs on an equal basis and combines a variety of classifiers is proposed in the proposed study. According to datasets of heart disease predict form Stanford University medical data ensemble classifier was evaluated to determine how well it performed. Using a relief algorithm, the most important features were selected and the irrelevant ones were eliminated. As compared to previous approaches and individual classifiers, the proposed method provides hopeful results for cardio vascular disease diagnosis. Further research on the time difficulty of the proposed collaborative method is planned, as well as an investigation into new procedures that can be combined into the collaborative classifier to improve its all their performance.

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