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CLASSIFICATION OF SUBJECTS WITH CHOLESTEROL USING IRIS

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Abstract - *Cholesterol, natural substance present in human body, a fatty component required for most of the metabolic activity. Level of cholesterol greater than 200 mg/dL is considered as high cholesterol level and leads to critical illness such as hypertension, coronary heart disease etc. Iridology is a type of Complementary and Alternative Medicine, non-invasive diagnostic tool having the ability to detect the cholesterol at early stage. The concept of iridology is the analysis features of iris in determining the defective organ. This work combined the concept of iridology and deep learning, promising method in medical analysis, in identifying subjects with high cholesterol. In this study deep learning classifiers such as AlexNet, VGG-16, ResNet-18 and ResNet-50 were used for classifying subjects with high cholesterol and healthy.*

Key Words: AlexNet, Cholesterol, Iridology, ResNet-18, ResNet-50, VGG-16.

1. INTRODUCTION

Cholesterol is a fatty component present in the body. Cholesterol plays a vital role in carrying out various metabolic activities such as production of vitamin D and testosterone, helps in carrying out digestion process etc. [1]. Cholesterol circulates in blood using lipoprotein present in the blood. High density lipoprotein (HDL), Low density lipoprotein (LDL) and Very Low-Density Lipoproteins (VLDL) are types of lipoproteins present in human. HDL and LDL are often termed as good and bad cholesterol. If the concentration of cholesterol increases in blood it leads to various health issues such as coronary heart disease, stroke, peripheral arterial disease etc. Almost 75% of cholesterol in blood stream is produced by liver and remaining are obtained from the food. Level between 125 to 200 mg/dL is considered to be an ideal cholesterol level in blood value. The risk factor increases when the cholesterol level increases above 200mg/dL and this is termed as high cholesterol condition. The high cholesterol condition was diagnosed by analyzing the blood from subjects after undergoing 10 to 12 hours of fasting [2].

Iridology is considered as an alternative diagnostic tool for detecting the defect organ in human. In the concept of iridology, the iris was divided over 60 regions each representing a specific organ. It analysis the features of iris based on the shape and structure of iris to determine the defective organ [3]. High cholesterol can be identified by the presence of cholesterol ring or sodium ring on the iris which is of greyish or whitish that is visible on the edges of the iris often called as Arcus Senilis. It is caused by the fat deposit in the inner lining of the peripheral cornea [4]. Fig-1 shows the sample image of arcus senilis or sodium ring.

Deep learning is a subset of machine learning technique that mimics human activity. In this technique a computer model learns to perform classification tasks directly from images, text, or sound. Models are trained using a large set of labelled data and neural network architectures that contain many layers. The term "deep" usually refers to the number of hidden layers in the neural network. Traditional neural networks only contain 2-3 hidden layers, while deep network can have as many as 150 layers [5]. This study combined the concept of iridology and deep learning to classify subjects with high and normal cholesterol level using iris image.

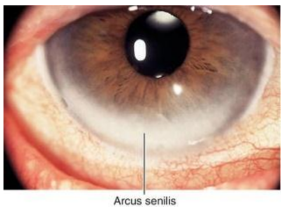

Fig-1: Image of Arcus Senilis [6]

2. RELATED WORK

R.A.Ramlee et al. [7] proposed Otsu's threshold based cholesterol detection system. Circular Hough Transform (CHT), parabolic Hough transform and Daugman's Rubber Sheet Model for detection of iris, eyelids and normalization of iris, respectively. Images of iris for high cholesterol level were collected from Mediscan and National Library of Medicine websites. Iris images from CASIA, MMU, UPOL and UBIRIS datasets were considered as healthy.

Dian Sari et al. [9] developed a Fuzzy Local Binary Pattern based feature extraction system for detecting cholesterol. The features were obtained from cropped iris image for detecting cholesterol. The iris images were captured using mobile camera from a hospital to carry out this study. 105 iris images were obtained from subjects of these 63 and 42 iris images were used to train and test the network. The system obtained accuracy, precision, recall and computing time as 95.23% 90.47%, 100%, and 40 ms, respectively.

Amini N et al. [10] in their work verified that AlexNet obtained 100% accuracy in determining iris images with and without sodium ring. Ridza Azri Ramlee et al [11]. In their study found that the 30% iris images with more than 139 as threshold values is considered as the distinguish factor between the healthy and unhealthy iris images after testing 30 healthy images. Vikas Bhangdiya et al. [12] found that as the eigen value increases the cholesterol value also increases.

Sruthi K et al. [13] in their study developed a 33-layer Convolutional Neural Network (CNN) to classify images among healthy, risk of cholesterol and high cholesterol level. The CNN based classification system obtained accuracy of 100%, 99.21% and 100% for healthy, risk of cholesterol and high cholesterol level, respectively.

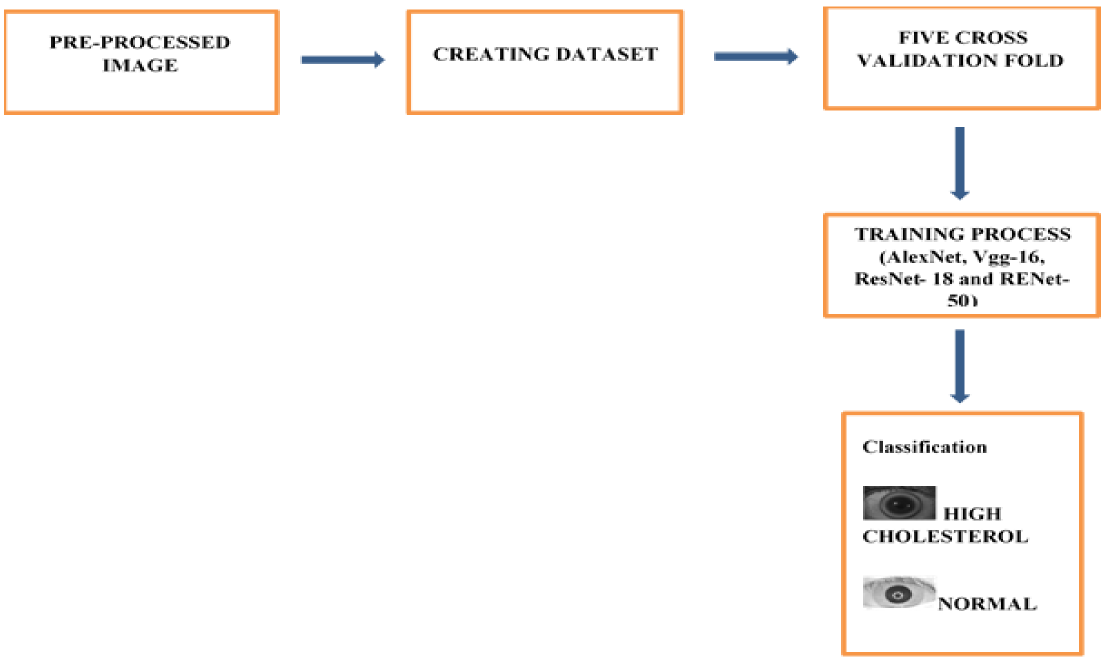

Fig-3: Process involved in classification of healthy and unhealthy iris image

The significances of the proposed work are as follows:

(i) Employed pre-trained model such as AlexNet, VGG-16, ResNet-18 and ResNet-50 for classifying iris images between health and unhealthy.

(ii) Compared the employed existing pre-trained model based on accuracy in classifying iris images into heathy and unhealthy based on the sodium ring.

3. METHODOLOGY

This section explains the work flow of the proposed methodology. Fig- 2 shows the pre-processing steps involved in the proposed algorithm.

Fig-2: Pre-processing technique involved in proposed Work

3.1 Pre-Processing

3.1.1 Input Iris Image

The human iris images used in the proposed work are obtained from IITD (IIT Delhi Iris Database), several websites and private health center. The IITD image was considered as healthy category and was used to train and test the network. About 50 arcus senilis images were obtained from various online medical websites and 149 images were obtained from a private clinic using Logitech webcam. Of the 149 images 102 belong to unhealthy category and 47 to the healthy category.

3.1.2 Image Resize

The images were obtained from various sources so they were of different sizes. All training and testing images should be of same size to train and test the deep learning architecture. So, all the used images were converted to 227 X 227 for AlexNet and 224 X 224 for VGG-16, ResNet-18 and ResNet-50.

3.1.3 RGB TO GRAY

The resized image is converted into a grey scale image to decrease the complexity of the process and as the image obtained from IITD dataset are NIR images. All the gray scale converted images have the channel as 3.

3.2 Proposed Technique

This subsection provides the detailed architecture of the network used for classification of cholesterol. Fig -3 shows the process involved in classification of healthy and unhealthy iris images based on the presence of sodium ring.

All the pre-processed images were separated into healthy and unhealthy iris images. Five-fold cross validation technique is employed to train and test the pre-trained networks. In cross validation technique each fold will be considered as a test set exactly i.e., when one-fold act as test set while the remaining will act as training set. The set which yields with maximum accuracy will be considered to test which are obtained further.

In the proposed work AlexNet, VGG-16, ResNet-18 and ResNet-50 pre-trained architecture were used. To train and test AlexNet the images were converted to 227 X 227 X 3. The VGG-16, ResNet-18 and ResNet-50 were trained and tested with images of resolution 224 X 224 X 3. The AlexNet consists of eight layers of these five are convolutional layers and three are fully connected layers. VGG-16 consists of 16 layers. First two layers in VGG-16 consist of 64 channels with filter size of 3 X 3. The third layer is a max-pool layer with stride as (2, 2) with convolutional layer of 256 channel and filter size of (3,3) followed by a max-pool layer as same as previous layer. Two convolutional layer one with 3 X 3 as filter size and 256 as channel and a max-pool layer followed by 3 X 3 filter size with 512 channel and same padding. The images are then passed to cascade of 2 fully connected layers. ResNet-18 consists of eighteen layers of deep CNN with 72 layers. ResNet-50 is a type of ResNet architecture having forty-eight convolution layers with one max-pool and an average pool layer and consists 3.8×109 floating point operations.

The data are simulated in the computer with Intel core i5 10500h CPU@ 4.5GHZ 6 cores, 64-bit Windows 11 operating system, 16GB RAM DDR4 4000MHZ with GPU of Nvidia RTX 3060 6GB GDDR6, SSD of 512GB equipped with MATLAB R2021a environment. The epoch is given as 100, batch size as 10 and learning rate as 0.0001 for all the pre-trained models.

4 RESULTS AND DISCUSSION

The original image of the iris is first resized (227 X 227 and 224 X 224) by using the image batch processing app, then the resized images are converted from RGB image to the grayscale image, thus pre-processing is done. The image is then trained by each of the network (Alexnet, VGG-16, Resnet-18 and Resnet-50), the below image (Fig- 4) shows the result of the pre-processed step (original image, resized image, and the grayscale converted image). Fig-5 and Fig-6 shows the classification result obtained for this system.

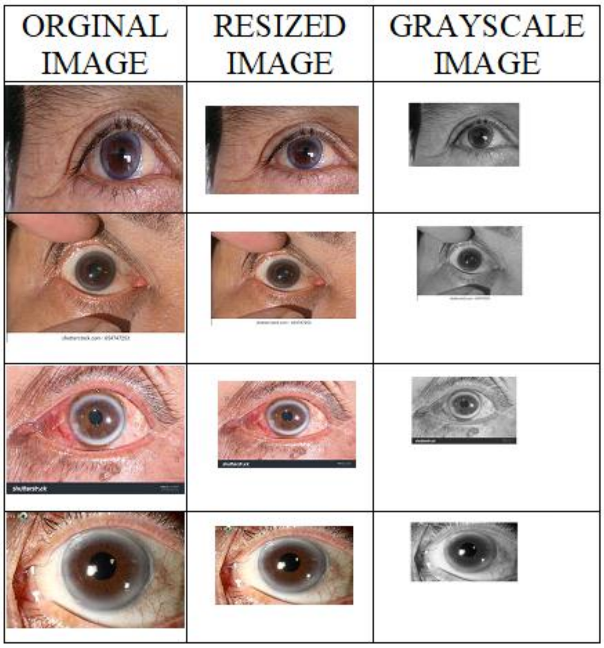

Fig-4: Pre-Processed image

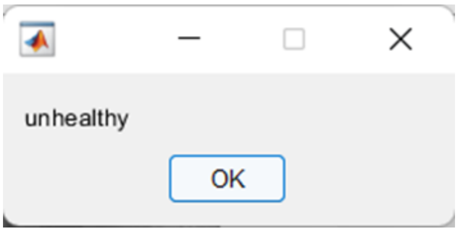

Fig-5: Final results of the unhealthy image

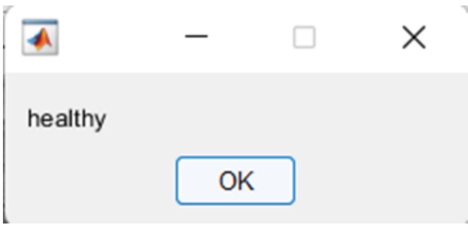

Fig-6: Final results of the healthy image

Table-1 shows the accuracy of the proposed network in classifying the image between two classes, normal image and the high cholesterol image. The system accurately predicts normal and high cholesterol. The reduction of accuracy in VGG-16 and the ResNet-18 is due the epoch assigned. The accuracy can be increased by increasing the pre-set of the in-built function 'Maxepoch'.

Table-1: Classification of Accuracy

NETWORK	ACCURACY
ALEXNET	100%
VGG-16	99.4%
RESNET-18	99.84%
RESNET-50	100%

The proposed classify the image into healthy and cholesterol based on the presence of sodium ring. In this work, the image batch processing was used to resize and to convert the RGB image to gray. The Alexnet, VGG-16, ResNet-18, and RestNet-50 was used for classification. An accuracy of 100% was obtained for Alexnet and Resnet-50. Accuracy of 99.4% and 99.84% was obtained for VGG-16 and ResNet-18, respectively in categorizing the iris image into normal and high cholesterol. The performance of the proposed system was compared with other existing systems and was tabulated in Table -2. This work is an elementary work extensive database has to be created to prove the effectiveness of iridology in detecting cholesterol.

Table-2: Comparison of Accuracy of the proposed system with the existing system

Sl. No.	Authors	Classes Classified	Accuracy (%)
1	Melvin Daniel et al. [8]	3	94.6
2	Dian Sari et al. [9]	3	95.23
3	Amini N et al. [10] (Alex)	2	100
4	Amini N et al. [10] (CNN)	2	98
5	Amini N et al. [10] (VGG-16)	2	98.5
6	Sruthi K et al. [13]	3	99.21
7	**Proposed system (Alexnet, ResNet-50)**	**2**	**100**
7	**Proposed system (ResNet-18)**	**2**	**99.84**
7	**Proposed system (VGG-16)**	**2**	**99.4**

5 CONCLUSIONS

This work compared the efficiency of the pre-trained model in categorizing the iris images into healthy and high cholesterol based on accuracy. This work found out that when the epoch value is increased the classification accuracy also increases. This system obtained 100% accuracy for AlexNet and ResNet-50. For ResNet-18 and VGG-16 obtained the accuracy of 99.84 and 99.4, respectively. Accuracy of these networks can be increased by increasing the epoch. The performance of the employed pre-trained models was compared among them and with other pre-existing system from which we inferred that AlexNet and ResNet-50 has better efficiency compared to other models. This work is a preliminary work a large number of data has to be collected to prove the efficacy of iridology in detecting cholesterol.

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