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Identification and Cholesterol Estimation of Skin Using Hand Pattern Image

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ABSTRACT: A novel identification and detection of cholesterol in the human body by non-invasive method using image processing is presented in this paper. Different sample of images with and without cholesterol are taken for the study. These images are analysed using mean algorithms in image processing to detect the cholesterol levels. The image of the patients' finger region is taken as sample images, along with their laboratory tested values of cholesterol. A database of different range of cholesterol values is created using these images. The sample images of different age groups are collected for the purpose of easy image analysis and accuracy. In image processing, the image analysis is done in various methods such as mean algorithm, median, standard deviation, histogram analysis, grey slicing method, etc. It was found that the mean algorithm is suitable for the non-invasive method of detecting the cholesterol levels. The mean value of the test image is then compared to the mean value of the images in the database to determine the cholesterol value. From the results it is found that the cholesterol mean values are proportional to the laboratory values. Thereby the correlations table is formulated.

KEYWORDS: image processing; cholesterol; correlation; average mean algorithms.

I. INTRODUCTION

The skin test for cholesterol detects the early signs of heart disease. Measuring the amount and types of cholesterol in the body is very important in preventing and detecting heart disease. If the body has more cholesterol than it can use to create hormones and build cells, this stockpiles in artery walls to form plaque. This plaque prevents the blood from moving properly through the body and the risk of a heart attack or stroke becomes serious. The skin test for cholesterol can help doctors assess a patient's risk for plaque build-up in the arteries (http://www.wisegeek.com/what-is-the-skin-testfor- cholesterol.html). Determination of skin cholesterol values, therefore, could provide an independent, inexpensive screening tool for individuals at risk of disease (Zawydiwski et al., 2001).Cholesterol is a fatty substance (a lipid) that is an important part of the outer lining (membrane) of cells in the body. Cholesterol is also found in the blood circulation of humans. The cholesterol can be identified by using iris images (Ramlee and Ranjit,2009). Many methods have been developed for cholesterol identification like for detecting intracellular cholesterol (Chang, 2008). New approaches to dietary management of elevated cholesterol have also become a vital area to reduce the cholesterol after identification (Eur Heart, 1999). Bhattacharya et al. (1972) had done the excretion of sterols from the skin of normal and hypercholesterolemia humans, Implications for sterol balance studies. The studies in the presence of sterol and squalene secretion by human skin had been proved (Nikkari et al., 1974). Still researchers are interested in identification of cholesterol in skin and their effect in the heart is also studied (Blum, 2003).Cholesterol in a person's blood originates from two major sources; dietary intake and liver production. Dietary cholesterol comes mainly from meat, poultry, fish, and dairy products. Organ meats, such as liver, are especially high in cholesterol content, while foods of plant origin contain no cholesterol. After a meal, cholesterol is absorbed by the intestines into the blood circulation and is then packaged inside a protein coat. This cholesterol-protein coat complex is called a chylomicron. The liver is capable of removing cholesterol from the blood circulation as well as manufacturing cholesterol and secreting cholesterol into the blood circulation. After a meal, the liver removes chylomicrons from the blood circulation. In between meals, the liver manufactures and secretes cholesterol back into the blood circulation. Cholesterol plays a major role in a person's heart health. High blood cholesterol is a major risk factor for coronary heart disease and stroke. That's why it's important for all people to know their cholesterol level. They should also learn about their other risk factors for heart disease and stroke. One can interpret the cholesterol numbers based on other risk factors such as age, gender, family history, race, smoking, high blood pressure, physical inactivity, obesity and

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diabetes. Total blood cholesterol is the most common measurement of blood cholesterol. It's the number you receive as test results. Cholesterol is measured in milligrams per decilitre of blood (mg/dL).Total cholesterol is the sum of LDL (low density) cholesterol, HDL (high density) cholesterol, Triglycerides. Both heredity and diet have a significant influence on a person's LDL, HDL and total cholesterol levels. For example, familial hypercholesterolemia (FH) is a common inherited disorder whose victims have a diminished number or non-existent LDL receptors on the surface of liver cells. People with this disorder also tend to develop atherosclerosis and heart attacks during early adulthood. The American Heart Association endorses the National Cholesterol Education Program (NCEP) guidelines for detection of high cholesterol. It recommends that everyone age 20 and older have a fasting 'lipoprotein profile' every five years. This test is done after a 9–12-hour fast without food, liquids or pills. It gives information about total cholesterol, low-density lipoprotein (LDL) or 'bad' cholesterol, high-density lipoprotein (HDL) or 'good' cholesterol and triglycerides (blood fats). Blood cholesterol for adults is classified by LEVELS. Normal range of cholesterol levels are 200 mg/dL or lower for a total count, but it is important to check HDL and LDL levels for a better analysis. To check HDL and LDL levels a blood lipid test will need to be done, which should also reveal triglyceride levels. Normal triglyceride levels are 150 mg/dL and below.

HDL is the good cholesterol and is considered normal at 40mg/dL whereas LDL is the bad cholesterol and should be less than 100 mg/dL to be at a desirable range. If your total cholesterol is 200 mg/dL or more, or your HDL cholesterol is less than 40 mg/dL (for men) and less than 50 mg/dL (for women), you need to have a lipoprotein profile done to determine your LDL cholesterol and triglyceride levels. If your cholesterol is high or you have other risk factors. Lowering high cholesterol can be accomplished with diet, exercise, and medication if needed. A physician will usually try diet and exercise first but may prescribe medication to help get levels down faster, depending upon weight factors and other uncontrollable factors such as age, gender, and family history.

II. SYSTEM DESCRIPTOR

Table 1 Total cholesterol level

TOTAL CHOLESTEROL LEVEL	CATEGORY
Less than 200 mg/dL	Desirable level that puts you at lower risk for coronary heart disease. A cholesterol level of 200 mg/dL or higher raises your risk.
200 to 239 mg/dL	Borderline high
240 mg/dL and above	High blood cholesterol. A person with this level has more than twice the risk of coronary heart disease as someone whose cholesterol is below 200 mg/dL.

HDL cholesterol is called the 'good cholesterol' because HDL cholesterol particles prevent atherosclerosis by extracting cholesterol from the artery walls and disposing of them through the liver. Thus, high levels of LDL cholesterol and low levels of HDL cholesterol (high LDL/HDL ratios) are risk factors for atherosclerosis, while low levels of LDL cholesterol and high level of HDL cholesterol (low LDL/HDL ratios) are desirable.

Table 2 HDL cholesterol level

HDL CHOLESTEROL LEVEL	CATEGORY
Less than 40 mg/dL (for men) Less than 50 mg/dL (for women)	Low HDL cholesterol. A major risk factor for heart disease.
60 mg/dL and above	High HDL cholesterol. An HDL of 60 mg/dL and above is considered protective against heart disease.

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LDL cholesterol is called 'bad' cholesterol, because elevated levels of LDL cholesterol are associated with an increased risk of coronary heart disease. LDL lipoprotein deposits cholesterol on the artery walls, causing the formation of a hard, thick substance called cholesterol plaque. Over time, cholesterol plaque causes thickening of the artery walls and narrowing of the arteries, a process called atherosclerosis. The liver not only manufactures and secretes LDL cholesterol into the blood; it also removes LDL cholesterol from the blood. A high number of active LDL receptors on the liver surfaces is associated with the rapid removal of LDL cholesterol from the blood and low blood LDL cholesterol levels. A deficiency of LDL receptors is associated with high LDL cholesterol blood levels.

Table 3 LDL cholesterol level

LDL CHOLESTEROL LEVEL	CATEGORY
100 to 129 mg/dL	Near or above optimal
Less than 100 mg/dL	Optimal
130 to 159 mg/dL	Borderline high
160 to 189 mg/dL	High
190 mg/dL and above	Very high

Triglyceride is the most common type of fat in the body. Many people who have heart disease or diabetes have high triglyceride levels. Normal triglyceride levels vary by age and sex. A high triglyceride level combined with low HDL cholesterol or high LDL cholesterol seems to speed up atherosclerosis (the build-up of fatty deposits in artery walls). Atherosclerosis increases the risk for heart attack and stroke.

Table 4 Triglyceride level

TRIGLYCERIDE LEVEL	CATEGORY
Less than 150 mg/dL	Normal
150–199 mg/dL	Borderline high
200–499 mg/dL	High
500 mg/dL and above	Very high

III. METHODOLOGY

In this project we take only the total cholesterol values into considerations. Our main criteria is to detect the cholesterol by non-invasive method. We use MATLAB software for image analysis. We collect the sample images along with the laboratory tested values. We collect the sample images of different age groups for the purpose of easy image analysis of the sample image under test and accuracy. In Image processing, the image analysis is done in various methods such as mean algorithm, median, standard deviation, histogram analysis, grey slicing method, etc. But we use mean algorithm as it is simple and more suitable for this project. We crop the sample images to a standard size in order to maintain standard database which would help in easy comparison. With the sample images we create a database of different range of cholesterol values. We create the database of the cropped sample images along with the mean values which is determined using mean algorithm in MATLAB. We correlate the mean values with the lab values. For high cholesterol image we get high mean values and for low cholesterol image we get low mean values. In order to find the cholesterol value of the test image, we take the photo of the patients hand and upload it in MATLAB work space. Then we crop the image to a standard size as that of the sample images. We write a programme in MATLAB for comparing the sample image under test with the images in the database. We compare the mean value of the test image with the mean value of the sample images in the database. On comparison we can match the mean value of the test image with the nearest mean value of the sample image in the database. Once we get the match that particular mean value is pointed out and correspondingly we can give the laboratory cholesterol values, since it is correlated with the mean value of the matched sample image in the database. By this way we can determine the cholesterol value of the patient and come to the result whether the patient is having high cholesterol or normal cholesterol or low cholesterol. We come to this conclusion on the basis of the range of mean values as classified in the database from low level to high level depending on different age group. We make this setup using MATLAB. When we click the capture button, the image in front will be captured using the digital camera using peripheral interface. Then the image will be displayed in the axes space. Then when we

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click the crop button the will be cropped to a standard size. When we click the Test button the mean value of the cropped image will be compared with the database and the desired result will be displayed as 'You have cholesterol or not'.

IV. RESULT AND DISCUSSION

In this project we take various sample images and crop it to a standard size. From these cropped images we get a range of mean values. These mean values are correlated with the corresponding laboratory values of the sample image. We classify the patients into different age group and correspondingly we set the mean values and laboratory values for the patient with the help of our database. Depending on this classification we obtain a range of mean values and laboratory values on basis of which we can conclude whether the person is having very high cholesterol, High cholesterol(desirable) and normal cholesterol.

Table 5 Age, laboratory values, category

Age group	Laboratory values	Mean values	Category
25 to 40 years	Below 120	Below 55	Low cholesterol
	121–200 mg/dL	55–103	Normal cholesterol
	201–250 mg/dL	104–133	High cholesterol
	Above 250	Above 133	Very high cholesterol
40 to 60 years	Below 120	Below 57	Low cholesterol
	121–200 mg/dL	57–105	Normal cholesterol
	201–250 mg/dL	106–135	High cholesterol
	Above 250	Above 135	Very high cholesterol

One can interpret the cholesterol numbers based on other risk factors such as age, gender, family history, race, smoking, high blood pressure, physical inactivity, obesity and diabetes. Cholesterol detection for adults using image processing can be classified on the basis of range of mean values. For normal cholesterol, the range of mean values must lie between the range of 55–103 for the age group of 25–40 years and 57–105 for the age group of 40–60 years. If the range of mean values lie between 104–133 for age group 25–40 years and 106–135 for the age group of 40–60 years then they have high cholesterol which is desirable. When the mean values are above 133 for the age group of 25–40 years and above 135 for the age group of 40–60 years then they have very high cholesterol, which is a major risk factors for coronary heart disease and stroke. Therefore these ranges of mean values are tabulated below.

V. CONCLUSIONS

The above tabulation is classified into two categories of age groups. That is from 25–40 years and from 40–60years. The sample images taken are classified into these two groups. Then these images will be analysed with the help of MATLAB software and then we obtain the mean values with the help of the mean algorithm. Therefore we obtain two different set of mean values from the two different age groups sample images.

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Figure 1 Sample image and its laboratory values with average mean value (see online version for colours)

Then these mean values are examined and a range is obtained on the basis of laboratory tested values. With this range of database we can conclude as till what range the normal cholesterol lies. So the range for the mean values and the laboratory values are tabulated as to which range is the cholesterol normal and to which range it is very high. This range does differ depending upon the age group. Some of the sample images of different age groups and different range of mean values and laboratory values are given below.

Figure 2 Sample image and its laboratory values with average mean value (see online version for colours)

Figure 3 Sample image and its laboratory values with average mean value (see online version for colours)

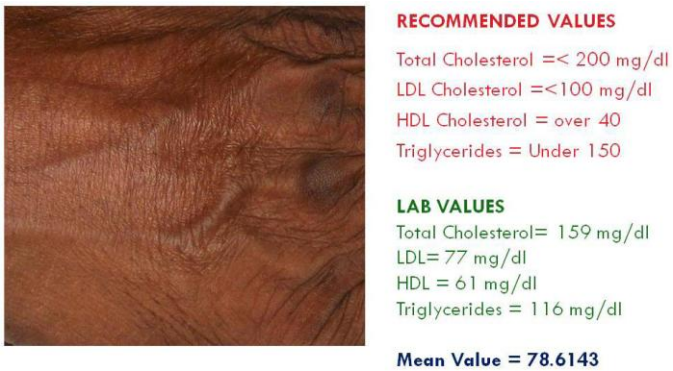

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Figure 4 Sample image and its laboratory values with average mean value (see online version for colours)

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