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Detection of clogged arteries using LabVIEW

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***Abstract*—**People suffering from peripheral artery disease -- a debilitating condition that can lead to heart attack and stroke has been rose nearly to 24 percent, 202 million from 164 million worldwide, over the past decade. Peripheral artery disease (PAD) is nothing but building up of cholesterol and plaque in the arteries that lead to the extremities. In reality, PAD and CAD both are related to a single disease, atherosclerosis, which is a buildup of cholesterol in the arteries throughout the body and which eventually leads to heart diseases like heart attack.

The diagnosis of heart disease starts from doctor checking the arteries through a stethoscope to detect any whooshing sound called as bruit which seems to be a crude method. Then certain blood tests are done through which levels of cholesterol, fats, etc. are checked. The Ankle/Brachial Index, followed by EKG (Electrocardiogram), Echocardiography, Computed Tomography Scan and Stress Testing. Final step is CCTA. Coronary CT angiography (C CTA) provides help in predicting heart attack risk in patients who are suspected to have coronary artery disease, but they mostly don't show signs of any other risk factors, such as high cholesterol elevated blood pressure, or diabetes. The method proposed here is to detect peripheral artery disease through nerves in the foot. It's safe to use unlike angiography where the suspected patients are exposed to special X-rays which might be harming. Also the time required for the results to generate is very less as well.

The implementation of this method is a graphical representation of different artery points of the foot. So the inference is very easy. Frequent testing can be done and by comparing the graph obtained during different tests can be compared with previous reports.

Keywords- *Arduino Uno, IR sensors, LabVIEW software*

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I. INTRODUCTION

Peripheral artery disease is mostly affecting all the general population unknowingly [1]. Hence most of the population doesn't even know that they are affected by it since they don't go for checkup. The present clinical checkup is having three most commonly used methods for detecting this disease. These three techniques are ankle brachial index, Doppler's test and toe brachial index [2]. Also some major risk factors of the cardiovascular disease are very well associated with the peripheral artery disease [3,4] .

In peripheral artery disease the arteries in the legs get clogged and hence the blood flow is restricted. To detect these clogging in ankle brachial index, the blood pressure is measured at the ankle and at the brachial individually and their ratio is calculated [2,5].

In Doppler's test, continuous wave Doppler gun is used to detect the clogging. The gun is kept over the predicted affected area and pictures of the waves reflected are transferred to a display device and the waves formed are observed for any abnormalities. In the third method blood pressure is measured at the toe point and the brachial point and their ratios are calculated and observed.

The blood pressure is mostly used as a parameter in detection of PAD methods instead of the blood pulse rate because the blood pulse rate does not get affected by the clogged arteries whereas the blood pressure gets affected since the blood flow is restricted more blood pressure is required to force the blood to flow through the clogged artery.

The accuracy of these methods is very less except the Doppler's test. The Doppler's test requires expert technicians to observe the waveforms generated from the reflections coming from the clogged arteries and make results [2]. Hence there is a need for a method to detect the peripheral artery disease easily and with around same accuracy and precision especially in the remote regions where there is a absence of the sufficient amount of expertise.

The other methods electrocardiogram, echocardiography and others are very expensive and complex. In addition to it, these machines as required are not available in rural parts of any country like India.

Here one such method is introduced. In this method, using some sensors the intensity of the blood flow in the particular arteries of the leg is measured and then compared with the readings of an healthy individual.

For detecting PAD, blood pressure is mostly used as a parameter [5]. The blood pressure is measured by two methods namely ausculatory method and the oscillometric method. In the oscillometric method, some pressure sensors are used to detect the oscillations generated due to pulses in the blood flow and plot the oscillations of the blood pressure. [6,7]

To measure the intensity of the blood flow infrared sensors are used along with some signal conditioning circuits. The principle of working for these sensors is quite easy. The light is emitted by the IR emitter (an IR led). It gets reflected back by the blood and is received by the IR receiver (a photodiode) [8].

II. WORKING PRINCIPLE

The proposed system consists of IR sensor module, Signal conditioning circuits, an arduino board and a personal computer (can be desktop or laptop)

The IR sensor module used in this work is specially designed for heart beat pulses measurement. Hence it has got a signal conditioning circuit in it. This circuit is made up of two op-amps configured as active low pass filters and some combinations of capacitors and resistors acting as AC filters. For op-amps, the IC used is LM328 consisting of two op-amps.

The data acquisition is accomplished by the use of arduino uno. The arduino uno board is used since it is the basic and most commonly used board. Hence easy to use. And also the board is required only for reading the analog values from the IR

sensor module and provide them to LabVIEW as shown in fig.3.

By using LabVIEW interface for arduino, all the analog readings are read in PC and written in a spreadsheet file and stored in PC.

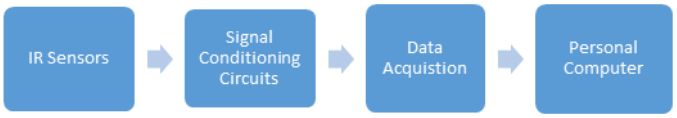

Figure 1: - Block Diagram

The arteries from where the signals are to be acquired needs to be identified. The arteries are palpated by bare hands. The IR sensor module is placed over them and the pulses are measured and recorded for 20ms in a text file. To confirm the voltage readings are from the arteries and not from anywhere else, the pattern of the waveforms generated are observed and compared with the waveforms generated by the same sensor module when it is kept over the tip of the forefinger of the hand.

Also the blood pulse rate per minute can be calculated and compared of the fingertip and that of the foot.

As in fig.2 the heart beat sensor chosen since in this particular type the sensitivity was found to be more than the other sensors which have been took under test while working during this work.

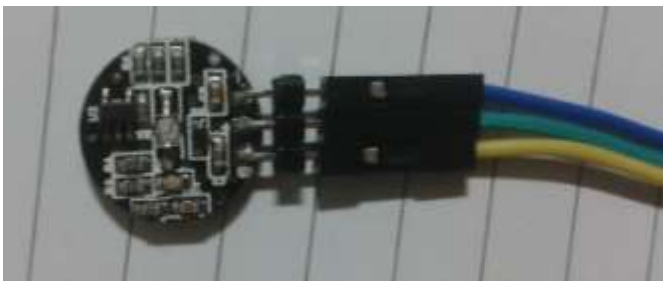

Figure 2: Heart beat sensor

Figure 3: Arduino Uno Board

As shown in the fig.4, the blockages could be formed anywhere in the branches of the femoral artery.

The plaque forms up due to the deposition of fats and other things. The reduction in the blood flow is called as the clogged.

These clogged arteries eventually becomes so high that the blood flow stops and then the muscle begins to die [15].

The arteries chosen for palapation and measurement of intensity of the blood flow are dosalis pedis and the posterior tibial [10,12].

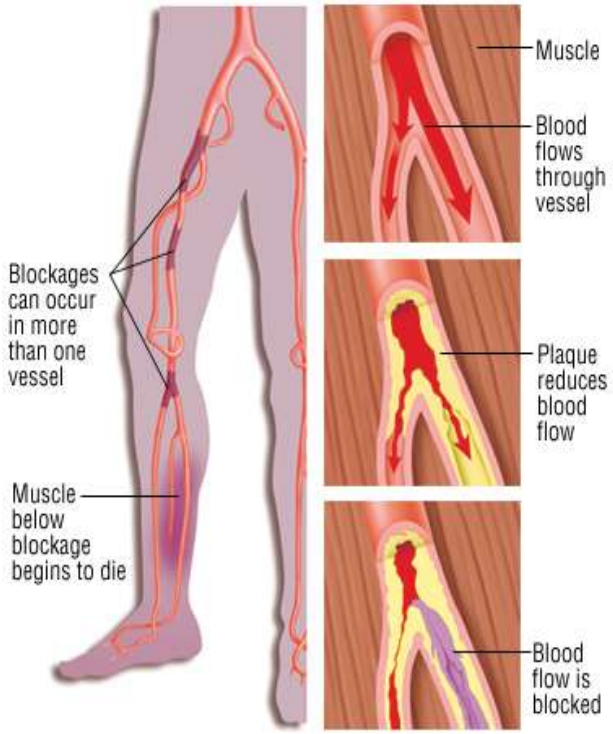

Figure 4: Location and schematic of blockages (courtesy: Google images)

After palpating the arteries the sensor is placed on the location and the reading are stored in a file using LabVIEW and arduino board. The block diagram of recording of the readings in LabVIEW is as shown in the fig.5

The arduino is initialized and then using analog serial read and while loop the readings are read in the PC. Using the write to measurement file and write to spreadsheet file, the readings are stored in the files.

The information received from the sensors is in terms of voltage values. Since more the blood flow more will be the reflection more will be the reception of light emitted by the IR LED and hence more will be the voltage received in the LabVIEW.

Since only the blood which flows through the arteries gives the reading of the blood flow rate [11].

The readings are the reflections of the intensity of the blood flow.

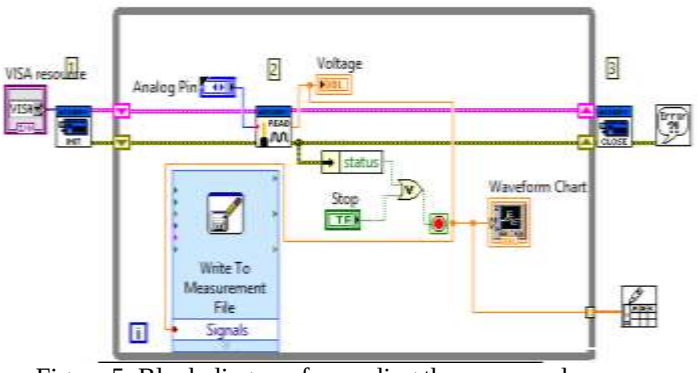

Figure 5: Block diagram for reading the sensor values

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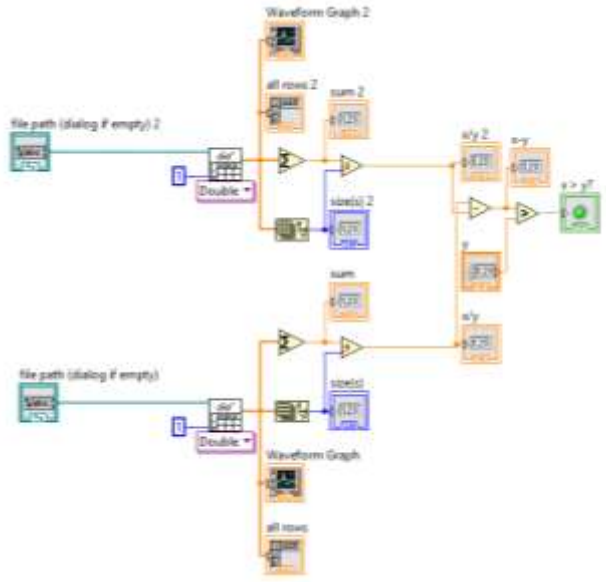

Figure 6: Block diagram to perform comparison of these readings

These readings are used from the files for comparison with each other. Here the readings of the healthy person (who has gone through complete medical checkup) are also kept stored and then used to compare with the readings from the person came for the test.

So the average of all the values is calculated each for the healthy person's reading and the patient's reading.

Then both the readings are subtracted. Mostly the average of the patient's reading is subtracted from the average of healthy person's reading. The block diagram for averaging and comparison of readings can be seen from the Fig.6

According to the difference in the readings of both the values it is decided whether the person is suffering from that peripheral artery disease or not.

III. RESULTS

The arteries are palpated first then the sensor module is kept over those arteries and the waveform is observed over the screen of the personal computer (here laptop).

After comparing and confirming it with the waveform of the heart rate from the finger point, the readings from the foot are recorded. As it can be seen from the fig.8, the readings read from the foot are getting stored in a spreadsheet file using arduino board and LabVIEW.

The files stored in the PC are retrieved again as shown in the block diagram of fig.7 and the readings of two persons, the patient and the healthy person's readings are compared. All the sample readings are summed up and their average is calculated. The averages are subtracted and the resultant value is observed. Here test5 and test7 are the files of the respective persons. The test5 file is of healthy person as it can be seen in the first graph indicator where the amplitude of the reflections of the IR sensor module are in between 2.6V to 3.6V while in patient's reading the amplitude is going up to 2.8V. The average of the reading of patient's reading is 2.517 while that of the healthy person is 2.7 and hence the difference is displayed as -0.184 under the label x-y

Figure 7 Experimental diagnosing

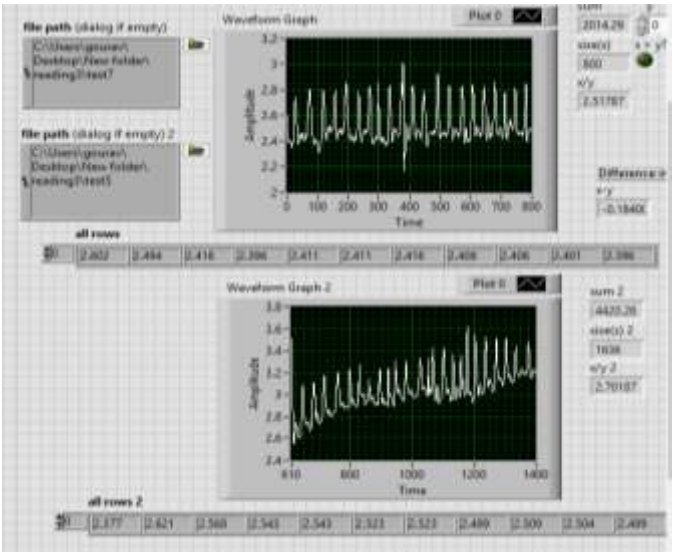

Figure 8 Front panel

If the average of the person came for testing is less than the average of the healthy person then the person must be suffering from peripheral artery disease and hence should go through further medical tests for confirmation.

This information is made available online through the use of web page publishing tool of the LabVIEW. Hence the doctors can view the information from across the globe.

IV. CONCLUSION

The system proposed here is able to get the readings from the foot but the readings were not perfect and as were supposed to be. Since the IR emitter's power required to penetrate through the skin was found to be much larger than the actual IR emitter's power. It can be overcome by increasing the no. of IR LEDs.

The system proposed here works very fast as compared to the Doppler gun. Also the LabVIEW software is very good for data acquisition [13].

There is also a facility provided here to change the file of the readings of healthy person directly as per the readings of different healthy persons according to the fat of the foot .

Also if the user wants to compare average of more no. of readings then it can also be altered in the front panel.

The sensors used are easy to use as compared to doppler gun where it requires to put some gel on the surface of the skin.

No expert technicians are required in detecting and palpating the arteries.

The readings from the foot differ from person to person based on the location of arteries in their foot.

It was also observed that if the foot is having too much flesh on it then these are rendered useless in getting proper reading.

To overcome this limitation either the no. of IR emitter LEDs needs to increase or else the power of the IR receiver is to be increased. The increase in reception power is difficult since it will be introducing noise also.

The second limitation is that these IR sensor modules used here are not FDA (Food and Drug Administration) approved and hence this system can't be implemented in any medical centers as it is.

V. FUTURE SCOPE

This system can be implemented in any medical cities if the sensors used here are replaced by FDA approved sensors.Also by increasing the IR emitter's power by increasing no. of emitter LEDs the accuracy and precision of this system can be increased multifold.

The same system can also be develop further for calculating heart beat rate and the blood pressure.

Also in this system in the comparison only one healthy person's readings are compared at a time though it can be increase to more than one in future for increasing efficiency of the system.

REFERENCES

[1] Leng GC, Lee AJ, Fowkes FG, et al. *"Incidence, natural history and cardiovascular events in symptomatic and asymptomatic peripheral arterial disease in the general population*." Int J Epidemiol 1996;25:1172—81.

[2] Daniel Benchimola, Xavier Pillois, Alain Benchimol, et al. **"***Non-invasive vascular assessment in the foot with diabetes: sensitivity and specificity of the ankle brachial index, toe brachial index and continuous wave Doppler for detecting peripheral arterial disease Archives of Cardiovascular Disease (2009*)" **102**, 519—524

[3] Aboyans V, Criqui MH. "*The epidemiology of peripheral arterial disease."* In: Dieter Robert, editor. Peripheral arterial disease. McGraw Hill; 2009.pp.1e25.

[4] Newman AB, Siscovick DS, Manolio TA, Polak J, Fried LP, Borhani NO, et al, Cardiovascular Heart Study (CHS) Collaborative Research Group. "*Ankle-arm index as a marker of atherosclerosis in the cardiovascular health study."* Circulation 1993;88:837e45.

[5] Daniel Benchimola, Xavier Pillois, Alain Benchimol, et al. "*Accuracy of ankle-brachial index using an automatic blood pressure device to detect peripheral artery disease in preventive medicine",* Archives of Cardiovascular Disease (2009) **102**, 519—524

[6] Gbenga Ogedegbe, MD, Thomas Pickering, MD, DPhilb,y. Principles and Techniques of Blood Pressure Measurement

[7] Dr. Neil Townsend, Medical Electronics, Michaelmas Term 2001 , Oscillometry

[8] Basem Abu Zneid, Mohammed Al-zidi, Tareq Al-kharazi, "*Non-invasive Blood Pressure Remote Monitoring Instrument Based Microcontroller",* 2014 IEEE Region 10 Symposium

[9] A.N.Nithyaa, R.PremkumarA, S.Dhivya, M.vennila, "Real time foot pressure measurement for early detection of ulcer formation in diabetes patients using LabVIEW", *Elseveir Procedia Engineering 64* (2013) 1302 – 1309

[10] Verena A. Steinberg, MD, Gottfried Mommertz, MD, et al. "*Effect of Peripheral Artery Sympathetic Denervation on Muscle Microperfusion and Macroperfusion in an Animal Peripheral Artery Disease Model Using Contrast-Enhanced Ultrasound and Doppler Flow Measurement",* J VascIntervRadiol2015;26:1396–1402

[11] Thomas R. Wyss a, b, Luise Adam a, Alan G. Haynes, "*Impact of cardiovascular risk factors on severity of peripheral artery disease*", Atherosclerosis 242 (2015) 97e101

[12] Kristian Barlinn, Reza Bavarsad Shahripour, et al., "*Increased Pulsatility of the Intracranial Blood Flow Spectral Waveform on Transcranial Doppler Does Not Point to Peripheral Arterial Disease in Stroke Patients*", Journal of Stroke and Cerebrovascular Diseases, Vol. 24, No. 1 (January), 2015: pp 189-195

[13] D. Luna-Moreno∗, Y.M. Espinosa Sánchez et al , "*Virtual instrumentation in LabVIEW for multiple opticalcharacterizations on the same opto-mechanical system" ,* Optik xxx (2015) xxx–xxx

[14] Salvatore Santo Signorelli et al*, "Patients with unrecognized peripheral arterial disease (PAD) assessed by ankle-brachial index (ABI) present a defined profile of proinflammatory markers compared to healthy subjects"* Cytokine 59 (2012)

[15] *Jeffrey L. Anderson, Jonathan L. Halperin ,et al "Management of Patients With Peripheral Artery Disease (Compilation of 2005 and 2011 ACCF/AHAGuidelineRecommendations)" Journal of the American College of Cardiology Vol. 61, No. 14, 2013 by the American College of Cardiology Foundation and the American Heart Association, Inc. ISSN 0735-1097/$36.00 Published by Elsevier Inc.*