

## DIAGNOSIS OF DISEASE USING WRIST PULSE SIGNALS

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**Abstract— In Traditional Chinese Medicine wrist pulse signals plays a vital role for disease diagnosis. In India cardiac related diseases are increased. The origin of all this is from atherosclerosis. Wrist signals are considered for detection of Atherosclerosis. The selected disease is early stage detection of heart attack. Basically diseases are caused due to imbalance in *tridoshas*. This wrist pulse diagnosis is also called as 'Nadi Parikshan'. It just requires two pulses as input, which are taken from patient's hand. In the system pulses of any two places of person are taken and PWV is calculated. This value of Pulse Wave Velocity is used to calculate Cardio Ankle Vascular Index value. Bases in the value various stages of disease are detected.**

**Keywords— Cardio Ankle Vascular Index (CAVI), Pulse wave velocity (PWV), Atherosclerosis.**

### I. INTRODUCTION

Heart contracts when blood flows from left ventricle to aorta. Thus pulse is produced. As wrist is majorly in contact with muscle, skin and other body parts it gives more information than fingers. Also accurate results are given by wrist pulses. [1] In this system some of diseases related to pulses are selected. So that pulses of any two places of person is taken and PWV (Pulse Wave Velocity) is calculated and this is used to calculate CAVI (Cardio Ankle Vascular Index) value used for detection.

Accordingly imbalances are detected through pulses that lead to Atherosclerosis. In this proposed system firstly the PWV of the person is detected and then accordingly it will check for Atherosclerosis problems. This detection depends on range of values of CAVI. The following block diagram fig 1.1. shows the whole proposed system to be developed. The certain steps required for detection is shown in flow chart fig 1.2.

Another technique used for detection cardiac disorders segmentation technique is proposed by using scanned image and detecting IMT intima-media thickness. has been designed to assist in the early detection of atherosclerosis and the prevention of cardiovascular diseases.[2]

Sumitra Pundlik, Pritam Rikame discussed different devices for pulse reading. Such as 'Nadi Aridhal', in which it classifies different chronic diseases which uses piezo sensors. Another system explained in which microphone is used and preprocessing of noisy signal is done by developing low pass filter. Next system explained is 'Nadi Taringini' in which pressure transducers are used. The author also explained some

applications of wrist pulses. Applications as stress detection can be done by acquiring different features of body through wrist. Also diabetes detection can be done. This is done by collecting blood samples and neural network. Also they are used for detection of inflammation. Thus by using different sensors and related feature extraction, large number of diseases can be diagnosed. [3]

Narendra Khaire, Yashwant Joshi proposed that wrist pulses give very important information of human body that it can also tell whether person has taken meal or not or either he is hungry. An amplifier is developed at particular frequency accordingly feature extraction is done. Accordingly using classifier persons are classified as on basis of healthy and disease. For this classification Support Vector Machine is used. In this system microphone is used as sensor hence preprocessing is done to remove noise from it.

The signal recorded and preprocessed consist large data. To acquire require data from it fast Fourier transform is used. Accordingly large numbers of recordings were taken in particular age. The whole system concluded the pre-meal signals gave more accuracy than post meal signals. Thus in future the emulation of signals recorded can be done by developing particular system. [5]

C. Narayanan, S. Revathy discussed that diseases are diagnosed using wrist keeping three fingers on particular position of wrist. Thus b observing amplitude, waveform shapes diseases are detected. Every human body consists of three elements. Thus imbalance in these three elements is diagnose to detect disease. This diagnosis of pulses is mainly diagnosis of heart rate and flow of blood. A system in which piezoelectric sensor is used to diagnose pulses and accordingly mean factor of it is calculated. Thus increasing or decreasing of this mean factor provides health conditions. According mean factor for different ages is calculated.

Mean factor is calculated on basis of age and heart rate of person. Thus this system of mean factor plays an important role in diagnosing chronic diseases. This makes analyzing different diseases and properties of human body using mean factor calculation. [6]

Dimin Wang, David Zhang proposed that readings taken from array of sensors gives more accurate results. Thus multichannel system can be used for accuracy. In this paper diabetes is considered and accordingly comparison of healthy and diabetic patients was done. Also many different types of sensors such as pressure sensor, photoelectric sensor etc. compared for their performance and photoelectric was selected for getting information from pulse. This paper concludes that single channel gives accuracy of 85.6% while on the other hand multichannel with photoelectric sensor provides accuracy of 90%.

Also single channel, two channel and three channels results accuracy is compared. For all three types of channels results accuracy using pressure sensor, photoelectric sensor and fusion sensor is also done. Accordingly feature distribution and data organization of healthy and diabetes patients is carried out with multiple results. [7]

## II. STUDY OF DISEASE ON BASIS OF PULSES

Wrist signal plays important role in diagnosis of diseases. Thus using pulses of hand of patient diagnosis of diseases such as Atherosclerosis can be done. This health problem is selected, as nowadays there are many cardiac related problems. These cardiac problems also cause death of person. This is early stage of heart attack. **ATHEROSCLEROSIS** is one of the reasons leading to high chances of occurrence of cardiac related deaths.

Atherosclerosis is a disease in which plaque builds up inside your arteries. Arteries are blood vessels that carry oxygen-rich blood to your heart and other parts of your body. Atherosclerosis can affect any artery in the body, including arteries in the heart, brain, arms, legs, pelvis, and kidneys. As a result, different diseases may develop based on which arteries are affected.

- PWV is calculated using sensor.
- CAVI depends on PWV.
- The instrument so designed to diagnose Atherosclerosis is based on two basic parameters i.e. Pulse Wave Velocity (PWV) and Cardio Ankle Vascular Index (CAVI).

This is diagnosed depending on CAVI values. Its values are as below:

- CAVI (7-12): No Atherosclerosis
- CAVI (14-21): Chances of Atherosclerosis
- CAVI (Above 21): Atherosclerosis

Different diagnostic tests are :

- Blood Tests
- EKG (Electrocardiogram)
- Ankle/Brachial Index
- Stress Testing
- Chest X Ray

## III. STUDY OF PULSE WAVE VELOCITY

Heartbeat wave speed or PWV is the speed at which the blood vessel beat proliferates through the circulatory framework. PWV is utilized clinically as a measure of blood vessel solidness. It is anything but difficult to quantify obtrusively and non-intrusively in people, is exceptionally reproducible, has a solid connection with cardiovascular occasions . A high heartbeat wave speed (PWV) has likewise been related with poor lung work. PWV is a marker of target organ harm and a helpful extra test in the examination of hypertension. PWV required to be calculated for cardio vascular problems .As it detects blockages in arteries .As cholesterol increases PWV increases. Thus PWV plays vital role in this proposed system as CAVI depends on PWV, which in turn helps in diagnosis of atherosclerosis.

### PWV = Distance / Transit time delay

PWV requires calculation of distance and transit time delay. Out of these two factors distance between two is provided by international biomedical standards as 0.85m. Hence it requires calculating transit time delay. the time required for a particle to traverse the distance between two specified points. These two specified pints are pulses taken at two places.

## IV. STUDY OF CAVI

Blood vessel solidness is a surrogate marker for the advancement of cardiovascular malady. The cardio-lower leg vascular list is an as of late created clinical metric for assessing blood vessel firmness. Two qualities of CAVI, which makes it amiable for far reaching use, is its straightforwardness of estimation and the way that it is moderately autonomous of circulatory strain. A few late clinical investigations have demonstrated the conceivable utility of CAVI for recognizing patients at high hazard for cardiovascular illness and for checking treatment viability in lipid centers. CAVI is the parameter used to gauge the measure of solidness of any supply route. CAVI fundamentally relies upon Pulse Wave Velocity and Blood Pressure vales.

CAVI is calculated by formula given by Bram-well-Hill's equation and is derived **from the stiffness parameter  $\beta$**  first proposed by a group of scientist working under Hayashi in 1980.

$$CAVI = 2 \times \text{Blood Density} \left[ \ln \frac{\text{Systolic Blood Pressure}}{\text{Diastolic Blood Pressure}} \right] \times \text{Pulse Wave Velocity}^2$$

Where:

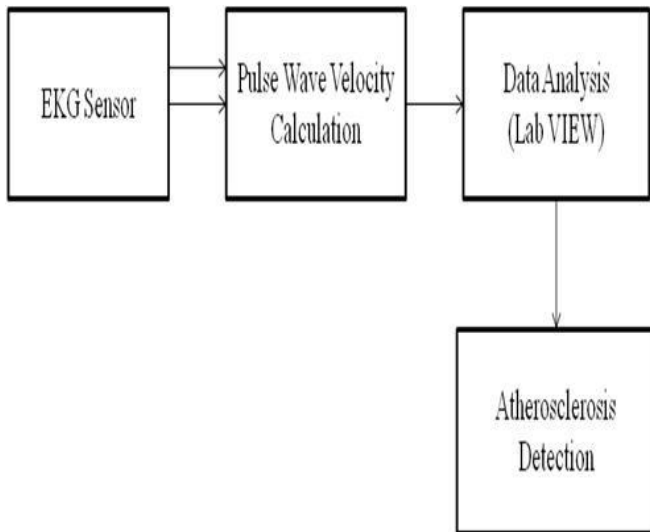
Pulse Pressure = Systolic Blood Pressure – Diastolic Blood Pressure.

## V. PROPOSED WORK

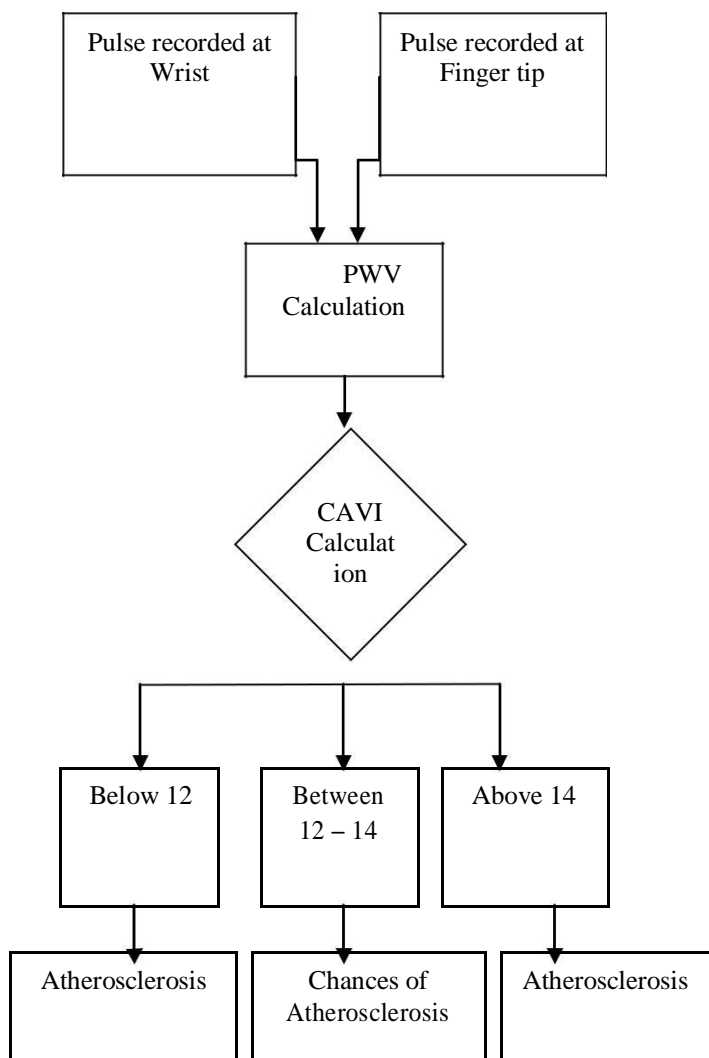
In this proposed system as shown in figure 1.1, single EKG sensor is used. It is required to read pulses from wrist and fingertip. From this pulse signals at two different places, the difference of peaks is calculated for calculation of PWV. The PWV is calculated by using peak of pulses from two. The main aim is to calculate CAVI (Cardio Ankle Vascular Index).But this CAVI formula contains PWV hence it is first calculated and further detection is done Pulse Wave Velocity calculation is required for calculation of CAVI.

This CAVI value is used for Atherosclerosis detection. Basically this detection consists of three different factors that will be displayed as atherosclerosis, possible chances, no

atherosclerosis. All of these three factors depend on value of CAVI.



**Fig.1.1.** Block Diagram of Diagnosis of Disease from Wrist Pulse Signal

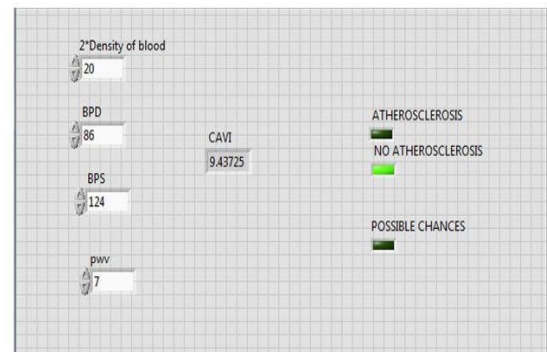


**Fig.1.2.** Flow Chart for diagnosis of Atherosclerosis

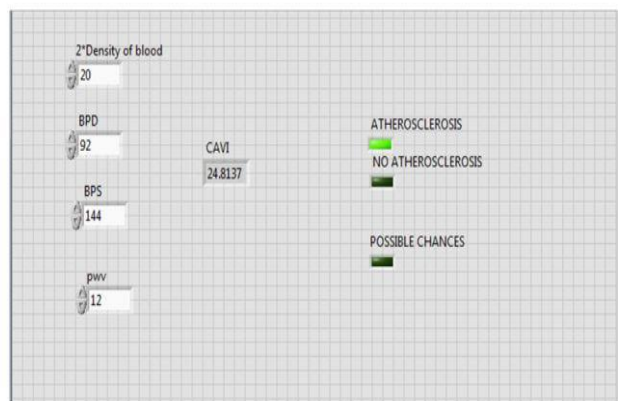
Fig.1.2. shows the flow chart for diagnosis of atherosclerosis. Pulses recorded from two distinct places are recorded and converted to excel files. Taking these excel files as input provides value of PWV. This in turn is used to calculate CAVI, required to diagnose. Below shown are the values on which three cases of diagnoses is done: CAVI (7-12): No Atherosclerosis  
 CAVI (14-21): Chances of Atherosclerosis  
 CAVI (Above 21): Atherosclerosis

## VI. RESULTS

### CASE 1: Normal Person

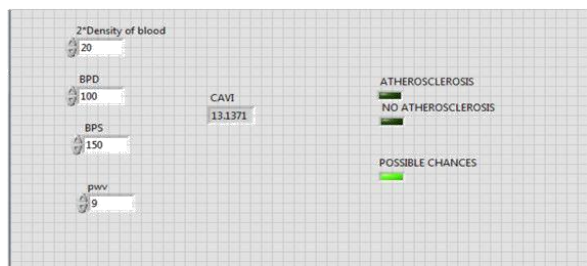


### CASE 2: Atherosclerosis



- PWV Diseased range : 10-12m/s
- CAVI (Atherosclerosis) : Above 14

**CASE 3: Possible Chances**



- PWV range : Around 8-10m/s
- CAVI (Possible Chances) : 12 -14

**VII. CONCLUSION**

Developing such a system can cover the bridge between wrist signals i.e. Nadi Shashtra and new technological instruments for early diagnosis of different health problems. Such a non invasive system is developed using LAB view or also can be developed using any other software. Requirement is of two pulses of same patient and its further mathematical calculation. This requires calculation of PWV and CAVI. There are varieties of different cardiac problems. Thus the same Atherosclerosis detection is also useful for diagnosis of some cardiac problems.

Basically according to overall study all the health problems related to heart, wrist can be detected using same mathematical calculation done in above system. These two calculations plays vital role in diagnosis of cardiac problems. Thus a little more study and minute changes in program will provide different diagnosis too. Making some minor changes in programming and mathematical calculation diseases like Psoriasis, Pregnancy problems can also be diagnosed using these pulses.

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