Implementation of Pulse Diagnosis System Using NI Labview

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***Abstract*— This project aims at the implementation of a simple and robust diagnostic device that can monitor the health status of an individual human and gives related information about the human body. In Ayurveda, the pulses of the Radial Artery are sensed by the fingertip, which measures the pressure exerted by the Radial artery in three location pulses namely Vata, Pitta, and Kapha. A pressure sensor is used for pulse detection. The signals that are obtained from the pressure sensor are processed through the SCB-68 kitfurther, it is implemented by NI - LABVIEW module. The performance of the developed system will be evaluated by recording the pulses of people having different doshas. The shapes of the pulses will be analyzed using amplitude and frequency analysis then the analyzed signal will be compared with the standard signal and accordingly subjects will be classified as Vata, Pitta, and Kapha type. This will be an aid to the Ayurvedic experts for better diagnosis.**

Index Terms: **Kapha, NI LABVIEW, pitta, pressure sensor, radial artery, SCB – 68 kit, subjects, vata**

INTRODUCTION

In earlierdays, pulse diagnosis used the signals obtained from the three accuratepositions on the wrist at the radial artery. Vata, Pitta, and Kapha played acrucial role in Traditional Ayurvedaand Chinese Medicine. The signals obtained from these positions as shown in fig 1 are due to the contraction and relaxation of blood vessels as a result of the movement of blood through the artery and the change in their diameter. [1]

Ayurveda states that every living thing in the universe is made of five elements. In humans, these elements correspond to the five senses:

Earth or Prithvi = Smell

Water or Apa = Taste

Fire or Tejas = Vision

Air or Vayu = Touch

Space or Akash = Hearing

Fig 1. Sensing Vata, Pitta, and Kapha Pulses

As time is passing by, electronic devices are deflated in size and price. By taking aid of this advanced technology, our demands are leading to health care that gives better quality of life [2]. People are interestedin the Indian culture and are trying to adapt it into their daily life from the ancient Indian medical sciences for their Holistic approach when compared to the modern allopathic treatment.

SIDDHADIAGNOSISPROCEDURES

The three different pulses are sensed by Siddha experts by their knowledge. The position for acquiring the necessary pulse is 2cm up from the wrist. The index, middle, and ring fingers are used to find the three pulses in their respective order as shown in Fig 1 and Fig 2.Also, it is said that analysis of hollow organs and semi-solid organs is done by feeling the nature of pulse at the deep and surface layers of the wrist radial artery by applying proper external pressure.

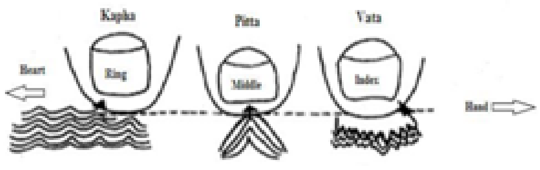


Fig 2

The pulse sensing method is not the same for males and femalesi.e; the Right arm is used for the male and the left arm is used for female subjects. [4]

The Heart rate of people of different ages are shown in Table 1:

Table 1

Newborn (0 – 3 months)	100 – 150
Infants (3 – 6 months)	90 – 120
Infants (6 – 12 months)	80 – 120
Children (1-10 years)	70 – 130
Children over 10 years & adults, including seniors	60 – 100
Well trained adult athletes	40 – 60

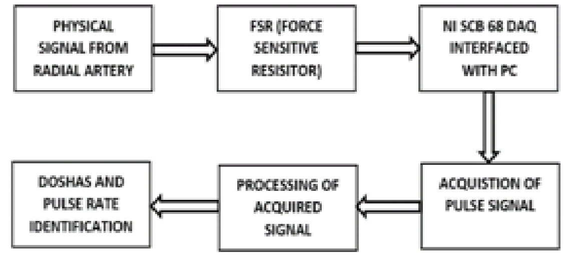
Table 2

Observations	Vata	Pitta	Kapha
Body size	slim	medium	heavy
Body weight	low	medium	overweight
Chin	thin, angular	tapering	rounded
Cheeks	wrinkled, sunken	smooth, flat	rounded, plump
Eyes	small, dry, active, black, brown, nervous	sharp, bright, gray, sensitive	big, beautiful, blue, calm
Nose	uneven shape	long printed	short, rounded
Lips	dry, cracked	red, inflame	smooth, oily
Skin	thin, dry, cold, rough, dark	smooth, oily, warm	thick, oily, cool, white
Hair	dry, black, brown	warm, straight, oily	curly, thick, oily, waxy

Instead of identifying bodies by heart rate, we can also identify the body types by analyzing their physical body structure like the type of skin, the color of hair, size and the weight of the body, etc. The three doshas will have different characteristics as shown in Table 2, which shows the sight, and nature of the body.[7]

II. METHODOLOGY

Block Diagram



Physical Signal from Radial Artery: The physical signal from the radial artery is the pulse pressure signal. The RADIAL ARTERY is present at the root of the thumb 2cms below the thumb. The red color nerve indicated as the radial artery is used for performing pulsediagnosis.[3] The physical signal here is a pulse pressure signal that is sensed by an FSR a force-sensitive resistor. By the application of pressure from the radial artery on the FSR, it shows a variation in resistance hence the input signal is transformed into a pulse signal.

Fig 3. Radial Artery

Force Sensitive Resistor: A force-sensitive resistor (alternatively called a force-sensing resistor or simply an FSR) has a variable resistance as a function of applied pressure.

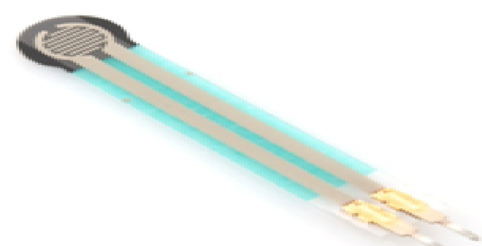


Fig 4. SEN¬-09673

In this sense, the term “force-sensitive” is misleading – a more appropriate one would be “pressure-sensitive”, since the sensor's output is dependent on the areaon the sensor's surface to which force is applied.

FSRs are sensors that allow you to detect physical pressure. The FSR is made of 2 layers separated by a spacer. The more one presses, the more of those Active Element dots touch the semiconductor and that makes the resistance go down.

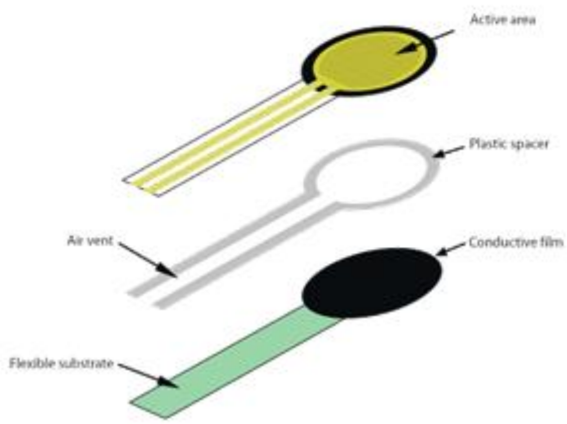


Fig 5. Internal layers of FSR

Fig 5. Shows the internal layers of FSR, when an external force is applied to the sensor, the resistive element is deformed against the substrate. Air from the spacer opening is pushed through the air vent in the tail, and the conductive material on the substrate comes into contact with parts of the active area. The more of the active area that touches the conductive element, the lower the resistance. All FSRs exhibit a "switch-like response", meaning some amount of force is necessary to break the sensor's resistance at rest (approximately 1 MΩ) and push it into the measurement range (beginning at approximately 100KΩ).

Shielded Connector Block(SCB) 68:

Fig 6. SCB – 68 KIT

The SCB-68 is a shielded I/O connector block with 68 screw terminals for easy signal connection to a National Instruments 68-pin or 100-pin DAQ device. The SCB-68 features a general breadboard area for custom circuitry and sockets forinter changing electrical components. These sockets or component pads allow filtering, 4 to 20 mA current input measurement, open thermocouple detection, and voltage attenuation. The open component pads allow you to easily add signal conditioning to the analog input (AI), analog output (AO), and PFI 0 signals of a 68-pin or 100-pin DAQ device.

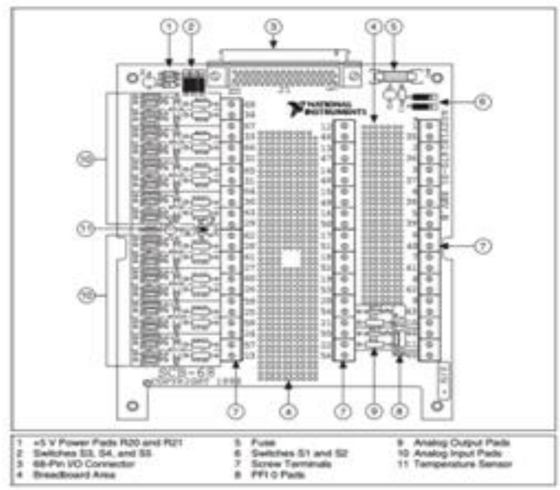


Fig 7. SCB-68 Architecture

Fig7 shows the internal architecture of SCB – 68 kit.

NI LabVIEW:

LabVIEW is developed and produced by National Instruments as an environment used for graphical system design. The name LabVIEW is a shortened form of its description: Laboratory Virtual Instrument Engineering Workbench. LabVIEW is a visual programming language: it is a system-design platform and development environment that was aimed at enabling all forms of systems to be developed. [6] LabVIEW was developed by National Instruments as a workbench for controlling test instrumentation. However, its applications have spread well beyond just test instrumentation to the whole field of system design and operation.

Butterworth Filter: The principle behind filters is quite simple, although the actual implementation can become complicated, depending on the specifications of the filter. A Butterworth filter has the maximally flat response in the pass-band. At the cut-off frequency, fc, the attenuation is -3dB. Above the -3dB point the attenuation is relatively steep with a roll-off of - 20dB/decade/pole.[7]

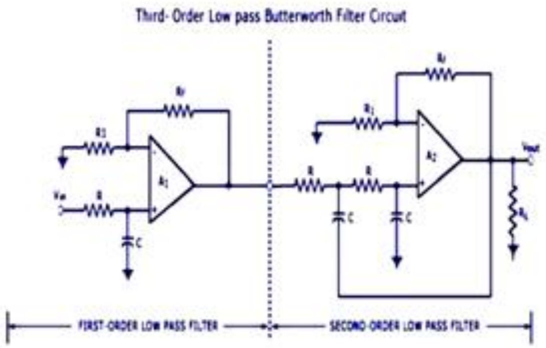


Fig 8. Butterworth filter

Fig 8 shows the circuit diagram of the 3rd Order Butterworth filter.

Order of the filter – 3rd order
Upper cut-off frequency – 2.25Hz
Lower cut-off frequency – 0.45Hz
Type of filter used – Low pass

$$\frac{V_{OUT}}{V_{IN}} = \frac{A_F}{\sqrt{1+\left(\frac{f}{f_C}\right)^6}}$$

where

$A_F = A_1 * A_2$ = Pass band gain of the filter

$$A_1 = 1 + \frac{R_F}{R_1} = \text{Gain of } 1^{st} \text{ stage}$$

$$A_2 = 1 + \frac{R_F}{R_1} = \text{Gain of } 2^{nd} \text{ stage}$$

f = Frequency of the input signal (Hz)

$$f_C = \frac{1}{2\pi RC} = \text{Corner frequency}$$

Implementation of Butterworth Filter in LabVIEW

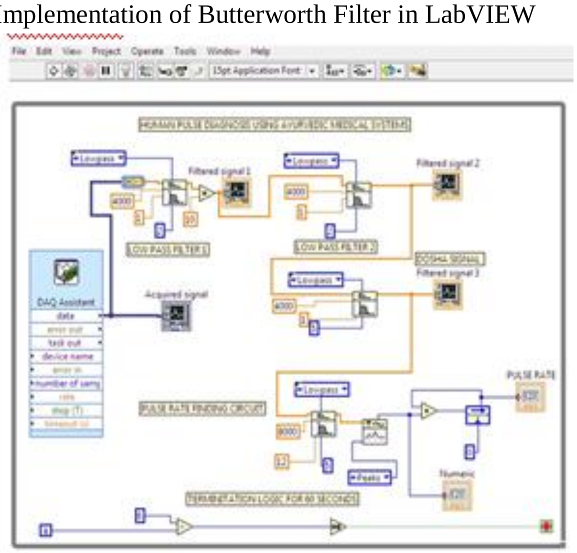


Fig 9. Implementation of Butterworth filter in NI LabVIEW

In Fig 9 butter worth filter used as a low pass filter in order to eliminate the high-frequency noise components. The pulse signal is smoothened by using three low pass filters as shown in the above block diagram.

III. RESULTS AND CONCLUSION

Fig 10. Acquisition of Pulse Signal

Vata analysis: Fig 11 shows the waveforms and pulse rate obtained for three different individuals possessing VATA dosha. The three waveforms are compared with standard data waveforms to match them visually.Also, the pulse rates of the individuals are 84, 82, and 83 respectively, which satisfies the Vata dosha pulse rate of 80-95.

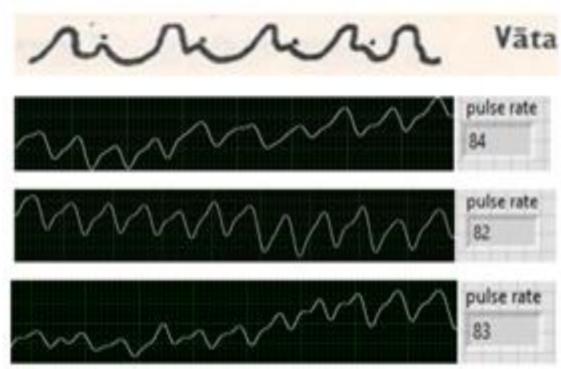


Fig 11. Vata Analysis

Pitta analysis: Fig 12 shows the waveforms and pulse rate obtained for three different individuals possessing PITTA dosha.The three waveforms are compared with standard pitta waveforms to match them visually.Also, the pulse rates of the individuals are 75, 76, and 78 respectively, which satisfies the pitta dosha pulse rate of 70 – 80.

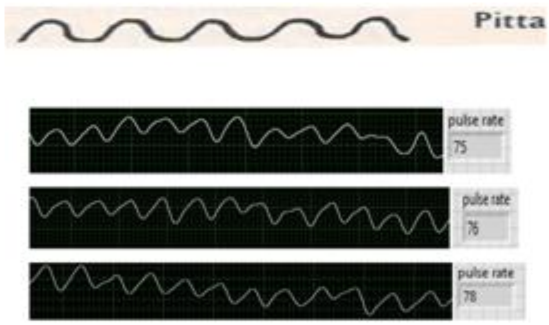


Fig 12. Pitta Analysis

Kapha analysis: Fig 13 shows the waveforms and pulse rate obtained for three different individuals possessing KAPHA dosha. The three waveforms are compared with standard Kaphawaveforms to match them visually.Also, the pulse rates of the individuals are 58, 56, and 62 respectively, which satisfies the Kapha dosha pulse rate of 50-60.

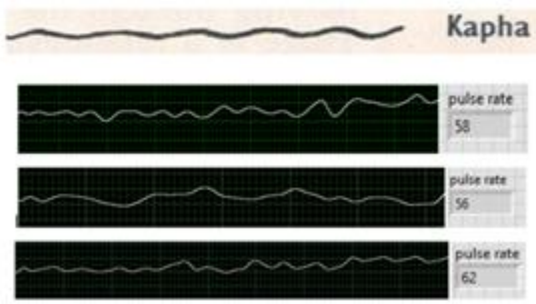


Fig 13. Kapha Analysis

Table 3-Samples taken from different subjects

NAME	PULSE RATE (DIAGNOSTIC DEVICE)	PULSE RATE (PALPATION)	AGE	DOSHA
Vikranth	84	85	23	VATA
Suraj	82	81	21	VATA
Anitha	83	85	19	VATA
Vinay	75	77	22	PITTA
Latha	76	73	20	PITTA
Sujatha	78	74	18	PITTA
Ravi	58	55	21	KAPHA
Vijaya	56	58	23	KAPHA
Rakesh	62	61	22	KAPHA

IV. CONCLUSION

This work presents the design and development of a pulse diagnosis system. The system has designed a system with three pressure sensors which are positioned on a radial artery in order to get three pulse signals Vata, Pitta, and Kapha. In order to remove the noise-induced due to the signal interaction with the skin and muscles, the Butterworth filter of suitable order has been designed. The developed system has been used in real-time data collection. Further, the collected data has been classified into Vata, Pitta, and Kapha based on the features extracted. This system will help the physicians who are not trained in pulse diagnosis and the prognosis of cardiac-related disorders. It also acts as a Portable Wearable device for home-based health monitoring.

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