

# Analysis of Radial Pulse Signals To Study Human Body Physiologically and Psychologically- A Review

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## Abstract.

Radial Pulse signals contain valuable information diagnosis of functioning of human body whose analysis has been in practice since many years in Indian Ayurveda, Traditional Chinese Medicine and Unani practices. These signals have three types of pulses- Vata, Pitta and Kapha that have certain parameters associated with them in the form of amplitude, rhythm and size of the pulse etc. These parameters get affected with any change in the human body- physiological and psychological. This is a highly efficient method to determine the status of human body. But the acquisition and analysis of this information is traditionally performed by an expert practitioner. Also the diagnoses from practitioner often vary due to their subjective knowledge and experience. Hence, computerised pulse diagnosis system came into existence for continuous analysis more efficiently and reliably. This paper presents the background of use of radial pulse signals to detect any physiological abnormality in the human body. Further, highlighting the possibility for the psychological analysis of humans using these signals.

**Keywords:** Ayurveda, Radial Pulse Signal, Psychological.

## 1. INTRODUCTION

According to Ayurveda, existence of any abnormality in our body results in the imbalance in the body. Curing such abnormalities by natural healing or using holistic medicine system brings our body back to balance. These systems are generally based on palpation techniques. 'Nadi pariksha' or pulse diagnosis is a one such powerful technique for identifying the disease in our system [1]. In different traditions such as Siddha, Ayurveda, Chinese, Unani, or Greek, pulse based diagnosis has its own unparalleled importance. Apart from India, presently this conventional method of diagnosis is practised in China, Korea and various other parts of the world. In this the diagnostic information of human body is studied by feeling the patient's artery pulsation with the practitioner's fingers from the three types of pulses in the wrist. The main purpose behind using radial pulse or the pulse in the radial artery of the wrist is, one can easily get the pulse as it is close to the skin [2] and also it contains much more information about the human health status of the human body in terms of both physiological and psychological. The foremost aim of pulse diagnosis is to obtain useful information about what goes on inside the body,

what has caused disease, what might be done to rectify the problem, and what are the chances of diagnosis.

The diagnostic method of observing the pulse begins with the practitioner placing the fingers on the wrist of the person. While recording the pulse the index finger is required to be placed below the radial styloid. The outward projecting wrist bone on the thumb side of the hand of the pulse recipient is known as Radial Styloid. This is the reason that wrist pulse signals are also known as Radial Signals. The middle finger, ring finger and the index finger are placed next to each other. The fingers that are recording the pulse should be placed in such a manner that they should feel the strongest pulse. When the blood is pumped by the heart it is carried by arteries with some pressure. This pressure on the walls of arteries generates the pulse. This pulse is like a wave with its own characteristics like crests, troughs, amplitude and cessation. On the whole movement, quality, and rhythm of the pulse is defined by these characteristics. The pulse diagnosis is the process of taking the information of the heartbeat in the form of a wave that is graphically represented as an image. The diagnosis of western practitioners considers only the rate of the pulse. This rate is dependent on the type of pulse that is recorded which according to Ayurveda is - Vata, Pitta and Kapha. *Vata, Pitta and Kapha* are 80-90, 70-80 bpm and 60-70 bpm respectively. There can be an irregular or regular rhythm of pulses. The intensity and rhythm of the irregular pulse like Vata fluctuates wildly and thus has no distinguishable pattern. A regular pulse which is Pitta is consistently pumps in the same rhythm and amplitude with even ups and downs. There is always a periodic repetition observed of skipping of a beat by Pitta. The amplitude of the pulse is defined as the force or strength with which the blood is pumped into the walls of arteries and is felt by the fingers. The intensity of Vata, Pitta and Kapha is low, high and moderate respectively. The characteristics of each pulse is summarised as: (i) The feeble and light pulse that slithers into the fingers is Vata, (ii) Pitta bounds into the fingers strongly and clearly and (iii) slow and cloudlike pulse that slithers into the fingers is Kapha. Hence inferring from the literature of Ayurveda and other traditional medicines it has been concluded that wrist pulse or radial pulse signals can give the complete physiological information of a human body.



Figure 1: Traditional method of diagnosis based on wrist pulse [3]

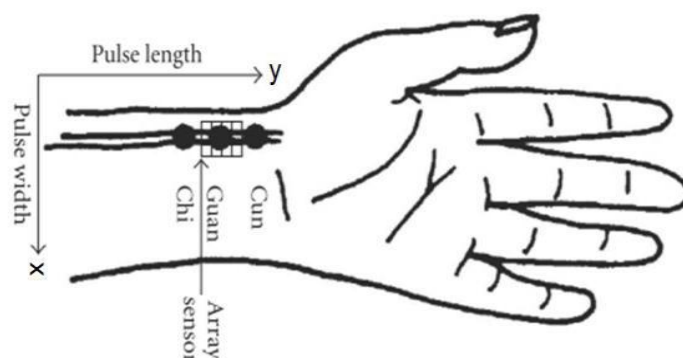


Figure 2: TCM wrist pulse points [4]

The recording and analysis of this information is traditionally performed by an expert practitioner. Due to the absence of well advanced technology the results may vary from one practitioner to another. Also this ancient manual system always relies on subjective analysis and lacking proper quantitative criteria, which affects the reliability and repeatability of any pulse diagnosis. Hence with the coming up of sensor and signal processing technologies there is an advancement in standardizing the measurement of the pulse and its various parameters. The human error generated during manual practice is eliminated by this non invasive computer aided technique and data collection system. Various different kinds of pulse diagnosis digitally are developed as the computer technology is getting advanced for better and reliable results in pulse waveform analysis and disease diagnosis. The different advantages for electronic pulse diagnosis are (i) Availability of computerised system with Ayurveda Practitioners to record and analyse the wrist pulse more efficiently. (ii) A frequency and time domain analysis of extracted features from these pulses can be done to detect any physiological change in the human body.

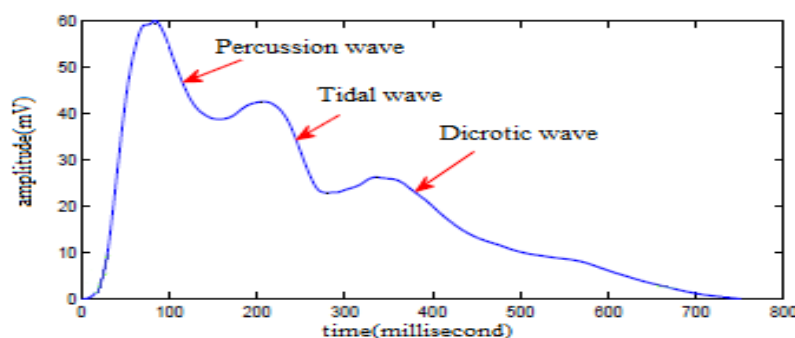


Figure 3: Radial Pulse Signal [5]

The computerised system consists of following blocks is shown in figure 4:

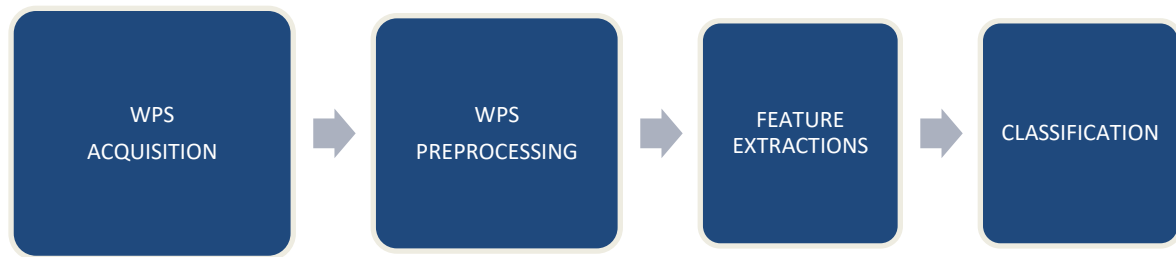


Figure 4: Block Diagram showing computerised Radial Pulse Signal System

Till now much of the research has been done on the detection of the abnormalities in the working of the body through Wrist pulse signals. This is a non invasive technique that eliminates the use of any costly diagnostic tests and easily helps a physician to diagnose a disease. However this technique has not been used by the psychologists yet to diagnose a problem on the psychology of a person and they still depend upon the psychometric tests to analyze a subject. The physiological signals especially RPS could help a psychologist to recognize the human emotions and diagnose them. Further it also helps in the creation of HMI system.

## 2. RELATED WORK

Since many years continuous research has been going on to study the various techniques of analysing Radial Pulse signal and utilising them to detect the physiological conditions of the human body. A system has been developed by Selvan and Begum for acquiring and processing the radial pulse signal, which feeds data into their Nadi Aridhal application for plotting the signal into pulse waveform graphs and analysing the probable disease diagnosis associated to the pulse waveform and the pressure applied at the sensing element [6]. Akshita proposed a methodology in which a system was developed for acquiring the pulse signals non invasively. It uses sensors and data acquisition equipment as the hardware circuitry and the signal processing system based on LabVIEW software intended for the successful recognition of diseases [7]. Khaire detected the condition of pre meal state and post meal state from the analysis of radial pulse signals [8]. Arun kumar et al. has stressed upon the sample entropy feature in the wrist pulse signal to differentiate between a diabetic and a non diabetic person [9]. Wangmeng Zuo et al. compared the wrist pulse signals taken from three different types of sensors-pressure, photoelectric and ultrasonic and studied the impact of various characteristics of these pulses for diagnosing different diseases [10]. Bhaskar Thakker et al. acquired the pulse signals and extracted certain features based on frequency and wavelet domain to classify between a healthy and an unhealthy person [11]. M.Sharmila Begum et. al. again worked with the pressure sensor to acquire the pulse signals and store the data in the digital form which was further used with different machine learning algorithms to classify the chronic diseases like obesity and diabetes [12]. Y. Chen. Et al. uses the auto regression model approach to acquired signals from Doppler ultrasound device and applying it to classify the patients with acute appendicitis with an accuracy of 82% [13]. Kulkarni et al. acquired three different pulses-Vata, Pitta and kapha using piezoelectric pressure sensors and extracting time and frequency domain features out of it to classify the diabetic patients using ANN [14]. In this paper, variations in the radial pulse signals have been analysed by Prajakta et. al. during fever, before and after meal, epileptic jerks, and recovery phase of typhoid. The pulse

signals are acquired using a suitable pressure sensor and further observes the imbalances of radial arterial signal in various abnormalities [15]. Diming wang et al. again worked with pressure sensors and detection of diabetes. However put more stress on the pre-processing stage of the pulse signal processing to make the system more reliable [16]. Zhang et al. presented a study on computerized pulse diagnosis based on blood flow velocity signal using Doppler ultrasound device. Hilbert-Huang transform- based method for spectrum feature extraction is undertaken which is used along with SVM to distinguish healthy people from patients with cholecystitis or nephritis [17]. Rangaprakash et al. worked with the wrist pulse signal to distinguish between before and after exercise case and before and after lunch case [18]. Joshi et al. inferred in their paper that there are eight morphological patterns associated with each pulse signal and their variations in the cardiac patients. Studying these patterns in each subject they are able to distinguish between healthy heart patients and those suffering from cardiac diseases like myocardium isochemia [19].

Hence it can be seen much of the work has been done in the field of analysing the radial pulse signal in a computerised manner and using it further to identify physiological change in the human body be it exercise meal or any other disease.

### **3. PSYCHOLOGICAL STATE AND RADIAL PULSE SIGNALS**

Psychological state of a person is the state of mind, the mood of a person that is being felt in a particular instant. Our pulse reflects the number of heart beats that take place in a given minute which is between 60 and 90. When sympathetic branch of our nervous system records any increase in the activity, pulse rate goes up while it goes down with this decrease. Conversely, when parasympathetic activity decreases, pulse rate goes up (because there is *less* inhibition). When it increases, it goes down (because there is *more* inhibition). Conclusively, the pulse rate and blood pressure are regulated by the autonomic nervous system which gets affected by the body's basic functions. The parameters like speed, size or rhythm of the pulse gets changed with the change in the mood..Hence the variations in the parameters of the radial pulse signals theoretically show there is a relationship between the psychological state of a person and its radial pulse signals

### **4. CONCLUSION**

This paper presents a brief overview on the holistic approach of radial pulse diagnosis or 'Nadi Pariksha' for the detection of any disease in the human body. The intense literature survey shows that several techniques have been applied to study these signals digitally using sensors. It also shows that what all diseases have been studied and how the improvements were brought about at each stage. The analysis of radial Pulse signal to psychological state is still an untouched area in this field. Radial pulse signals are directly affected by the blood flow, rhythmic activity of heart and nervous mechanism. The emotions changes the signal send by brain to heart to which the heart responds in the complex manner. This response of heart directly affects one of the parameters of wrist pulse hence affecting the signal. Negative signals like anger, fear generates erratic signals from heart affecting the blood flow due to constricting of vessel. On the other hand positive emotions like love, happiness generates smooth signal which regularizes the pulse. But the analysis of emotions through radial pulse signals is a challenging task which is discussed in the second section. Hence, Psychological state detection from the radial pulse signals

can be a future scope in this field. RPS approach have several challenges to detect emotions that are worthy of being explored.

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