H. Technology Corner

Centralized System for Heart Rate Variability (HRV) Analysis

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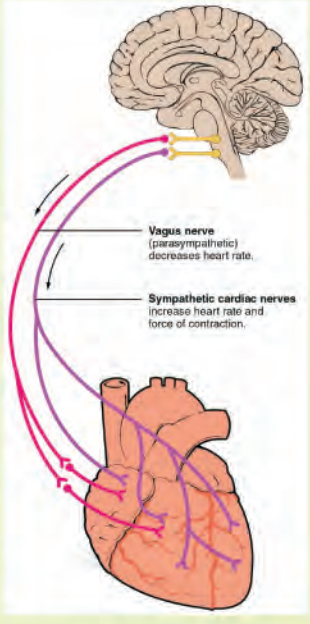
Background

Over 50 years of the research on heart rate variability has progressed from fetal heart rate variability to nearly involving all diseases. HRV has been found that derangement in one system influences levels of functioning of the other. Therefore, HRV becomes an important system performance indicator not only in healthy but to several diseases as well.

HRV is a measure of the naturally occurring beat-to-beat changes in heart rate. HRV analysis is a powerful, non-invasive measure of autonomic nervous-system function and an indicator of neurocardic fitness. The Heart rate is being regulated by the two limbs of the autonomic nervous system i.e. sympathetic and parasympathetic system. The balance between the two determines the heart rate and is subjected to variation on beat to beat basis even under resting condition. These beat to beat variation in the heart rate can easily be over look by the analysis of the heart rate variability (HRV). An extensive HRV normal/patients database provides data on the HRV of healthy individuals and how HRV varies with age and gender and on the use of HRV analyses to assess alterations in autonomic function in conditions.

The heart rate is a significant indicator of one's state of health around hundreds of years. However with the advancement of science and technology, it is being seen that the interval between the successive heart beats varies substantially from beat to beat. The degree of variability that exists was also found to be reflective of one's autonomic balance and degree of homoeostasis.



Dual Innervation of Heart

Current Status

Iin India considering the data available on PubMed, there are 180+ research papers published on heart rate variability analysis. These are research institutes who are working in this field. All of them are using desktop based HRVA solutions for undertaking the research and patient care.

All India Institute of Medical Sciences, New Delhi is in the field of autonomic function tests since 1992 and provides valuable diagnostic assistance to several departments including cardiology, gastroenterology, neurology, medicine, endocrinology, and pediatrics. The Lab has already developed desktop based software (HRV_Soft) for HRV measurement. HRV_Soft is a software package designed to perform state of art analysis of ECG data in the time domain, frequency domain and non-linear analysis. For development of HRV_Soft, the support was provided by DEITY, DST and CCRYN, Government of India.

Need of Centralization

There are several doctors/researchers using HRVA techniques for research and patients care. In the absence of availability of software (prohibited by cost or know how) several remote places are not using the technology. Thus, there is need to develop an innovative knowledge management framework for intra and inter institutional collaboration, cross-disciplinary, knowledge sharing system to empower medical practitioners, researchers and academics across the country for reproducible research and improved healthcare delivery. The needs are as follows:

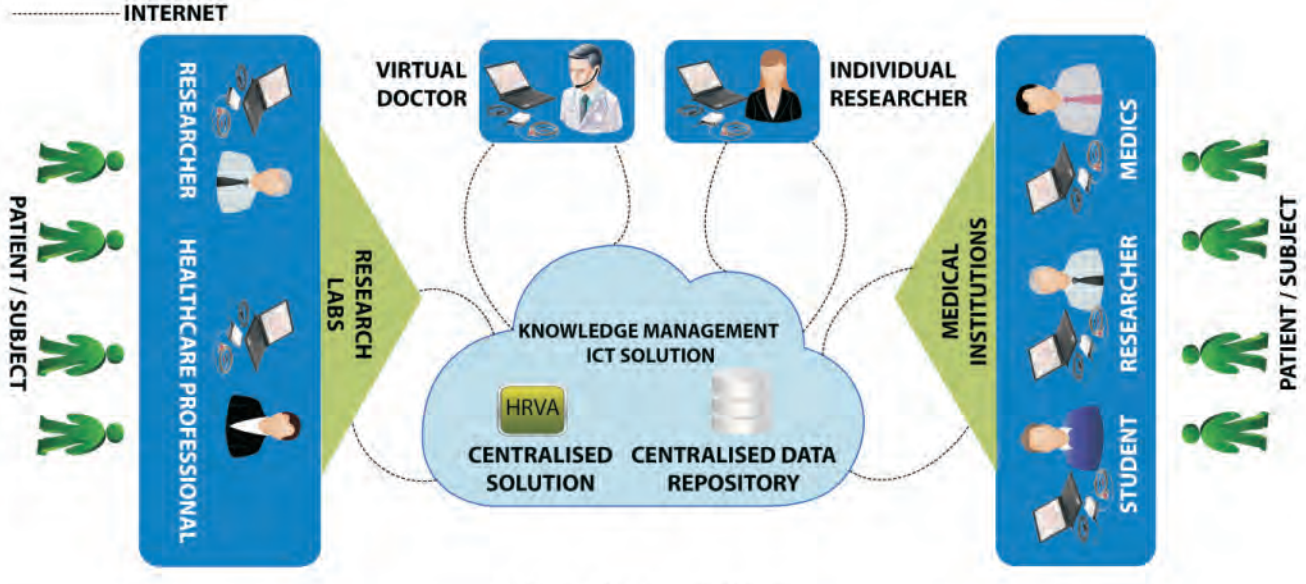
- To make HRV tool (Technology) available to remote places (In absence of availability of software (prohibited by cost or know how)several remote places in India)

HRVA Publications in India (Source – PubMed)

- To build up a national database on HRV for preventive & curative healthcare
- To provide the HRV tool in a more informative and advanced way (in portal format) so that users have easy access & knowledgeable health for their specific needs

Implementation of Centralization

- In HRV analysis, doctors/researchers use the time domain and frequency domain analysis outputs of heartbeat variations and correlate the output to ailments. Currently, the analysis is happening on individual desktops. In the proposed centralized solution the following data streams will be used to suffice the above objectives:
- Patient/Citizen data from research/health institutions, individual doctors and researchers.
- Public Health Data from central and state governments
- Disease specific data from researchers (institutions) and government departments
- Drug related data
- GIS data
- Access to topic specific articles from well know research repositories



Architecture of HRVA Centralized System

By integrating the above data sources, the centralized platform will be able to provide the following services to the user community:

- Single/Multiple HRV analysis of single patient/citizen
- HRV analysis of multiple patients/citizens
- Correlation of HRVA with other data streams which includes determining the clinical benchmarks associated to different conditions
- Information based indicators to the doctors/researchers to do intra/inter institutional referrals

To achieve the above, the centralized solution will be putting together a framework to present the analysis output via a custom built application, to give the ability to analyze data on the platform, to build applications using the data, and authentication & authorization policies to either restrict/publish data on the platform.

Technology Used

- The platform will be developed using multiple open source technologies and to name a few:
- OpenCPU is a software system for embedded statistical computation and reproducible research.
- R used as a programming language and software environment for statistical computing and graphics. The R language is widely used among statisticians and data miners for developing statistical software and data analysis.
- Database engines for processing efficiency and storing different types of data streams.

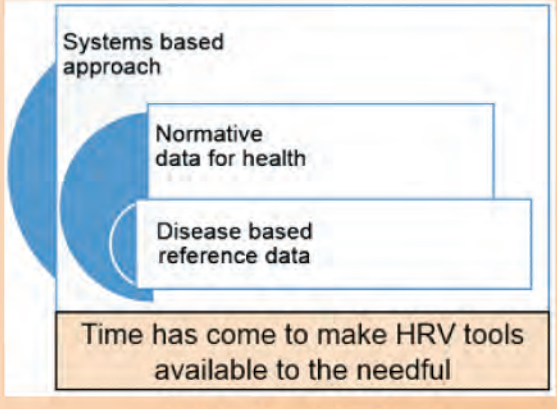
Benefits

The purpose of the system is to make this technology available to remote places and simultaneously to build up a national database on Heart Rate Variability Analysis and associated health data.

This is a stepping stone to many such digitization and centralization efforts which will help the research community, doctors, and public health administrators in planning and decision making on delivery of long term as well as emergency health services in the country.

End Users of the Technology

Doctors, Specialists, Researchers:	Institutional/ area of application:
✓ Physiologists , ✓ Pharmacologists, ✓ Cardiologists ✓ Endocrinologists, ✓ Neurologists, ✓ Psychiatrists ✓ Anesthesiologists	➢ Medical, ➢ Defense, ➢ Aerospace Medicine, ➢ Sport Physiology and medicine ➢ High Altitude Physiology and medicine



Outcomes of Centralized HRVA System

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innovating for Digital Inclusion
ISO 9001:2008 Certified

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