

Performance Analysis of monitored Biomedical Data using Biotrace tool

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Abstract: This paper is proposing a new approach to record physiological parameters such as ECG, EMG, BVP, SC from a remote location & Transmitting these signals to a medical practitioner. In this new proposed approach, physiological signal monitoring has been carried out using various sensors, Nexus 10 & Biotrace Software. These physiological signals would also be useful in training the functioning of autonomic and central nervous system. These signals would be helpful to control and improve their brain function i.e. attention & focus through audio video feedback. By embedded use of Biotrace which is the platform for physiological monitoring, signal processing, data analysis, and clinical biofeedback-neurofeedback is carried out. It is built from ground up, to be highly accessible for beginning users while offering a rich and deep set of functions for the more advanced user. With the extensive use of in build features for optimal support of the NeXus-4, NeXus-10, NeXus-16 and NeXus-32 systems and offers true dual monitor functionality so you need only one computer to run separate clinician and client screens.

Keywords: Electro cardiograph, EMG, EXG, Blood volume pulse, Heart-rate, Heart rate variability

I. Introduction

In this proposed new approach, mechanism is introduced for sensing & analyzing of a patient's physiological parameters i.e. blood volume pulse, Heart rate, RSP, SC and transmitting them to expert medical practitioner using Biotrace Tool. Biomedical sensors such as BVP, SC, HR and RSP along with Nexus 10 & Biotrace Software has been utilized to measure these physiological data. Medical combinational devices target this new market and not only power consumption a target but bringing better solution for disease control. Nexus 10 is a portable 10 channel physiological monitoring & feedback platform that utilizes Bluetooth wireless communication & flash memory technologies. Nexus 10 offers data acquisition at up to 2048 samples per second. The advanced technology has independent 24 bit A/D converter per channel with DC coupled amplifier allowing signals for 0 to 800 Hz including raw EEG, ECG, EMG, true DC & Slow cortical potential.

BVP Sensor

The blood volume pulse sensor is based on the Principle of photoplethysmography. It emits infrared light through the tissue (skin) and measures the absorption of light by the blood flowing through the vessel. Every time the heart beats, the sensor detects a peak in the absorption. The height of the pulse defines the measure of blood flow. When the blood vessel contracts, this is called vasoconstriction. When they expand it is called vasodilation. The interval or distance (B) between the peaks defines the heart rate (HR) which will be expressed as a millisecond (MS) interbeat interval or as the number of beats per minute. During each heart beat, blood flows through the arteries and blood vessel. At the peak of blood flow, BVP signal peaks. Height of the peak indicates relative blood flow.

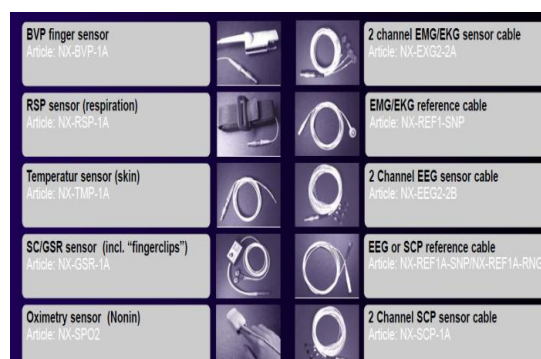


Figure 1: Physiological Sensors



Figure 2 : Nexus-10

Skin Conductance: It is a method of capturing the autonomic nerve response as a parameter of sweat gland activation. The activity of sweat gland in response to sympathetic nerve stimulation results in decrease in level of skin resistance. When human body relaxes, calm down or is peaceful, the resistance will increase and conductance will decrease.

RSP Sensor: This sensor is used to record respiration rates .Respiratory sensors measures the movement & expansion of the abdomen or chest. It is measured as breaths per minute.

Temperature Sensors: Transducer normally used for temperature measurement in a patients monitoring system is a thermister.

EEG Sensor: This Sensor is used to record brain waves.

EMG Sensor: EMG represents the electrical activity of the muscle to determine whether the muscles are functioning proper or not. When the muscle contracts, the signal increases its amplitude.

II. Related Work

Auto adaptivity and Optimization in Distributed ECG Interpretation

In this approach, ECG interpretation adaptively in a distributed surveillance network [8] is carried out. In this approach, distributed biosignal interpretation networks may not only optimally solve difficult medical cases, but also adapt the data acquisition, interpretation, and transmission to the variable patient's status and availability of technical resources. In the contemporary information society, remote surveillance, and heart diagnostic are widely spread benefiting from wearable computers and wireless digital communication .This technique, often put forward in context of cardiovascular off-hospital patients.

Wearable recorders do not limit the everyday subject activity while the embedded intelligence simulates well the continuous assistance of medical experts. Surveillance networks use a conventional star-shaped topology. They are managed by the central server and include several remote wearable recording devices communicating over a digital data link of worldwide range. Two approaches to the automatic signal interpretation represented in systems marketed today, assume either the transmission of the raw signal to the interpretation center CardioNet , Spacelabs , and Cardiobeat or the signal processing fully embedded in the remote device Welch AllynMicropaq , GE Healthcare SEER Light ,and QRS Diagnostic Biolog . Focusing on their drawbacks, first method involves high cost of telecommunication service, while the reliability of the second is limited as a result of the compromise between computing power and energy savings.

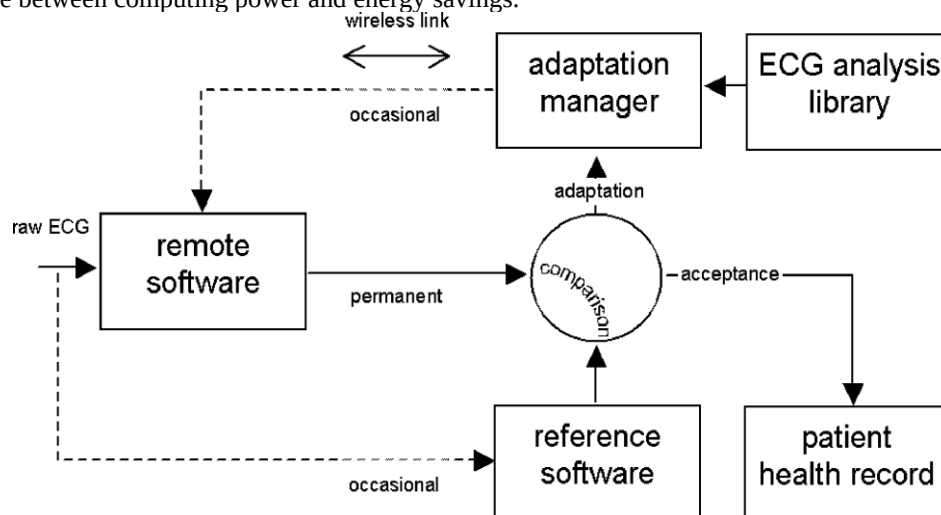


Figure: General scheme of the auto adaptive system for ubiquitous cardiology

Further Considerations

Most problematic is now the compatibility of the interpretive software designed for different platforms. Multiplying the interchange points, where the ECG interpretation could be taken over from the remote recorder and continued by the server. It affects the optimization of server interpretation thread.

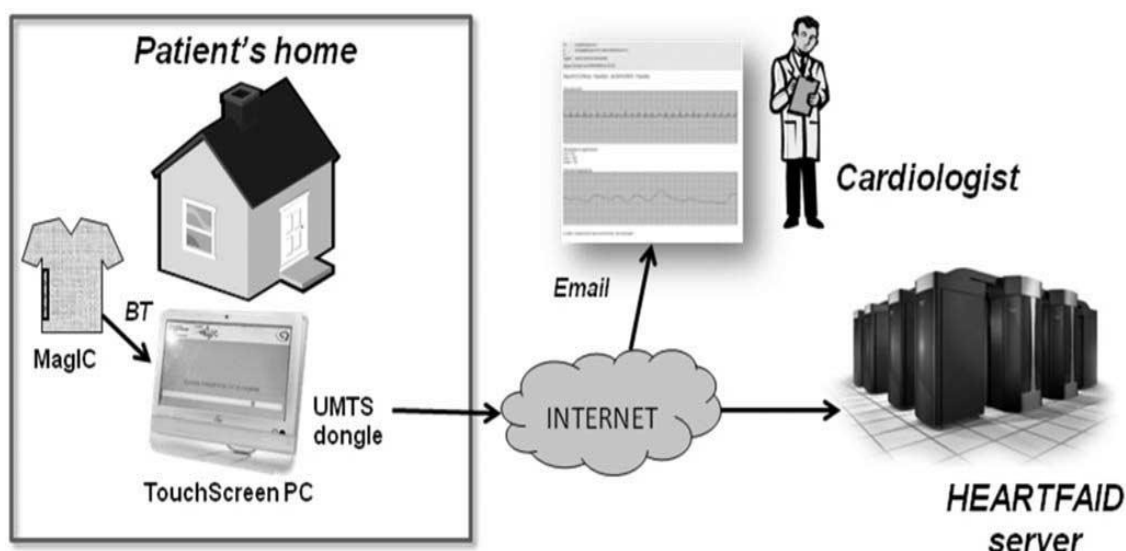
Data Security & Privacy in Wireless Body Area Network

The wireless body area network has emerged as a new technology for e-healthcare that allows the data of a patient's vital body parameters and movements to be collected by small wearable or implantable sensors and communicated using short-range wireless communication techniques[9]. WBAN has shown great potential in improving healthcare quality, and thus has found a wide range of applications from ubiquitous health monitoring and computer assisted rehabilitation to emergency medical response systems.

The security and privacy protection of the data collected from a WBAN, either while stored inside the WBAN or during their transmission outside of the WBAN, is a major unsolved concern, with challenges coming from stringent resource constraints of WBAN devices, and the high demand for both security/privacy and practicality/usability. In this article we look into two important data security issues: secure and dependable distributed data storage, and fine-grained distributed data access control for sensitive and private patient medical data. We discuss various practical issues that need to be taken into account while fulfilling the security and privacy requirements. Relevant solutions in sensor networks and WBANs are surveyed, and their applicability is analyzed.

Textile Technology for the Vital Signs Monitoring in Telemedicine and Extreme Environments

In this approach, two extensive applications of a smart garment developed for the monitoring of ECG, respiration, and movement [7]. In the first application, the device, named MagliettaInterattiva Computerizzata (MagIC), was used for the home monitoring of cardiac patients. The used platform included Magic for signals collection, a touch screen computer with a dedicated software for data handling, and a universal mobile telecommunications system (UMTS) dongle for data transmission, via email, to three cardiologists. Three patient's daily-performed 3-min telemonitoring sessions for 30 days by using the platform.



Telemonitoring of Cardiac Patients

The MagIC system has been selected as a reference wearable device for the home monitoring of patients suffering from CHF in the frame of the HEARTFAID European Project (FP6-IST-2004-027107). This project was aimed at developing an innovative knowledge-based platform of services able to support the clinical management of CHF patients, reduce the incidence of their rehospitalizations and improve their quality of life. For this application, we customized an integrated system previously developed in our lab. This system included the MagIC device for the vital signs assessment, a touch screen computer with dedicated software for data acquisition, and a UMTS USB dongle for data transmission.

III. Results & Discussion

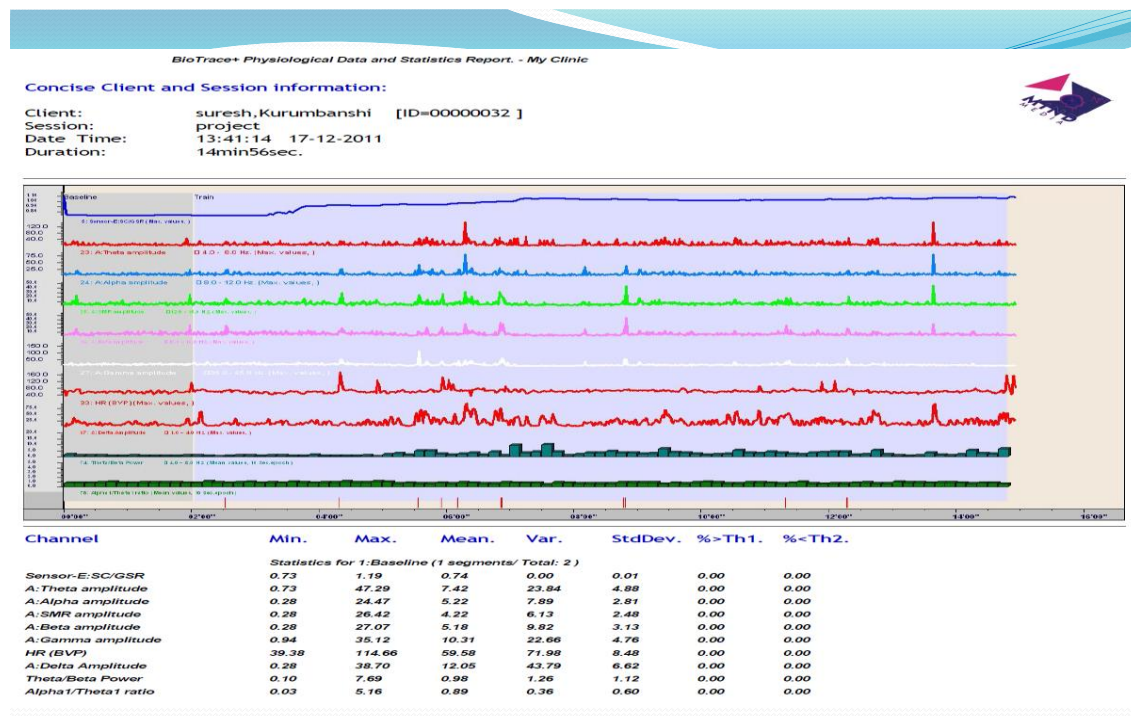
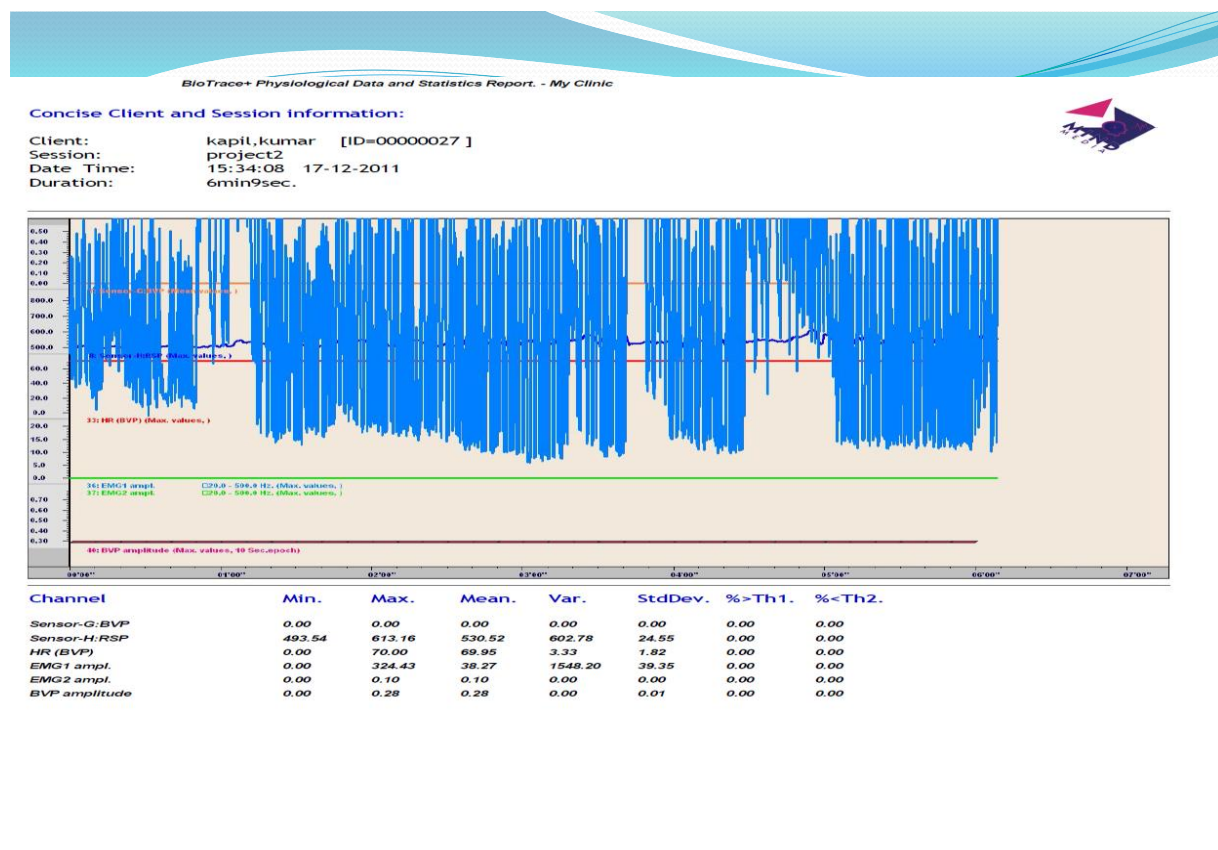


Fig 3: ECG & HR signal recording using Nexus-10 & Biotrace



BioTrace+ Physiological Data and Statistics Report. - My Clinic

Concise Client and Session information:

Client: suresh, Kurumbanshi [ID=00000032]
 Session: project
 Date Time: 13:41:14 17-12-2011
 Duration: 14min56sec.



Heart Rate Variability Analysis.

HRV channel 33:HR (BVP). 128 Samples/Sec.

Graphical overview of the RR Intervals (IBI table)

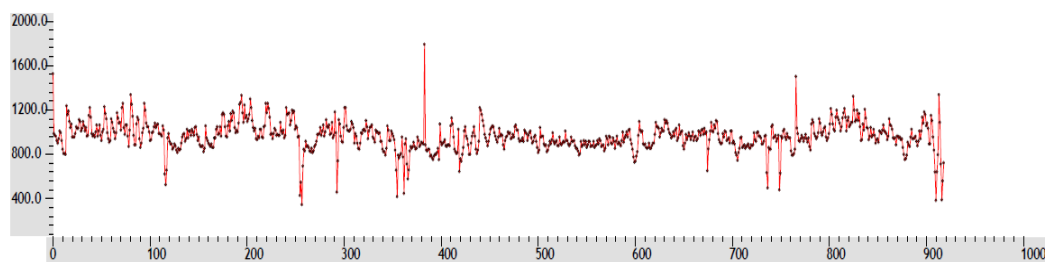
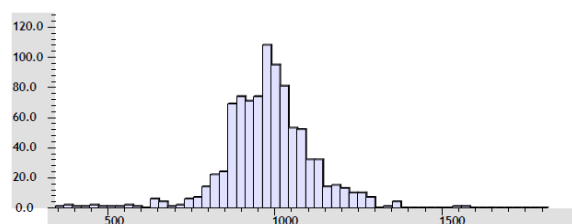


Fig 4: HRV Analysis

HRV Statistical Results

Statistic	Unit	Value
NNMin	(ms)	344.00
NNMax	(ms)	1790.00
NNMean	(ms)	960.45
SDNN	(ms)	129.86
RMSSD	(ms)	108.04
NN50	(count)	381
pNN50	(%)	41.55

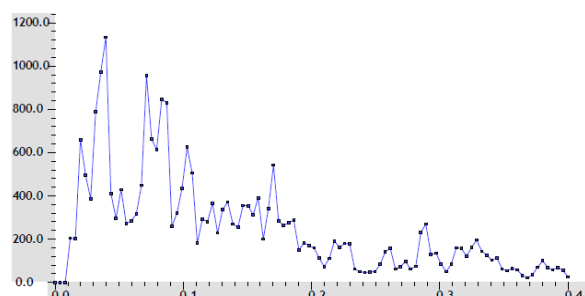
IBI Distribution



HRV FFT Results

Frequency	Unit	Value
VLF power	(ms ²)	3709.0
VLF %	(%)	14.68
LF power	(ms ²)	12581.8
LF %	(%)	49.81
HF power	(ms ²)	8966.7
HF %	(%)	35.50
LF/HF	(ratio)	1.4
LF Peakfreq.	Hz	0.039
LF Breaths/Min.	BPM	2.3

HRV Spectrum



Artifacts: 1.2% of the IBI data (11 beats out of 917) were rejected.

Note: The HRV Spectrum (0-0.4Hz) uses a non parametric FFT (1024 points) on detrended RR intervals, interpolated at 4Hz.

Fig 5: FFT & HRV spectrum

Table1 :Recorded data of Physiological sensors& its comparision with standard desired value

Name of Person	Parameter	Input of Sensor	Working Principal	Standard Value	Actual recorded value
Mr. Suresh Kurumbanshi	EEG	Brain Wave	This sensor senses electrical activity along the scalp.	Theta< 10 Alpha-Maximum SMR-Maximum Beta<10	Theta Amplitude-7.42 Alpha Amplitude-5.42 Beta Amplitude-5.18
	HR	BVP Amplitude	Phthoplethysmography	70-80 beats per minute	59.58 (baseline initial recorded for 2 minutes) 63.76
	SC/GSR (Galvanic skin resistance)	Nerve response	This sensor measures the electrical conductance of the skin.	Below 5	SC-0.74 (baseline) 0.98 (Training)
	RSP	Amplitude of respiration	Strain gauge Principle	6 breaths per minute for adults & 10-12 breaths per minute for kids	RSP rate-8.83

IV. Conclusion

The HR increases during inhalation and decreases during exhalation. This effect is called respiratory sinus arrhythmia (RSA), which is a representation of heart rate variability due to respiration over time. Breathing in will move the RSP signal UP while breathing out will move the RSP signal DOWN used in Biofeedback .When human body relaxes, calm down or is peaceful, the resistance will increase & conductivity will decrease. It is used in Biofeedback & can study person's internal state. This performance overview of this data and related study would be helpful to Physicians, Medical practitioners, Medical Professionals, Healthcare industry, Pharmaceutical Industry, Cardiac Doctors, Pharmacist for diagnosis and preventive cares. Sensors used here are currently used in many of the opulent and sophisticated hospitals which can use these techniques for further improvement. This proposed work would be useful to multi specialty for quick reliable diagnosis at low expenses.

V. Future Scope

In Biofeedback, people can learn to observe physical signals (body awareness) & train the functioning of autonomic and central nervous system. In Neurofeedback people will learn to control and improve their brain function i.e. attention & focus through audio video feedback. These recorded physiological signals will be uploaded on Website/ Mobile phone of a Doctor, retrieved data accordingly .This will be useful for doctors to refer reports of patient & advice him as per need. This study work can be used for remote patient monitoring in hilly areas, mountains, terrains and tribal areas with remote access. In country like India where acute shortage of Medical Practitioners and most of the Tribal areas can be deployed with by incorporating these techniques and can be useful for remote patient monitoring and diagnosis.

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