iJRASET
International Journal For Research in
Applied Science and Engineering Technology

INTERNATIONAL JOURNAL FOR RESEARCH

IN APPLIED SCIENCE & ENGINEERING TECHNOLOGY

Volume: 2 **Issue:** IX **Month of publication:** September 2014

DOI:

ISSN: 2321-9653

INTERNATIONAL JOURNAL FOR RESEARCH IN APPLIED SCIENCE AND ENGINEERING TECHNOLOGY (IJRASET)

Automated Radionics Device for Health-Care Solution in Global Area Networks.

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Abstract*—This paper shows a archetype of Automatic Machine for perfect health aided solution that adjoins mobile and Internet Protocol Version 6 and approaches in a Radionics sensor network to analyze the health condition of patients and afford a advanced range of Adequate, Effective, all-inclusive, and Comfort services. A low-Energy embedded personal wearable sensor scales the health criteria aggressively and allied, accordant to the technique of IPv6 superior to low-power wireless personal area network, to the Machine node for radionics transmittal via the internet or external IP-enabled networks over a port. A visualization element of the server program vividly displays the received bio medical signals on Android mobile application devices used by both patients and doctors at the end most networks in real-time process .In this article a detailed approach for a universal health care solution have been the charge to proceed the huge amount of bio medical signals through the prolonged network associating IPv6 technique and mobile technology for day to day lifestyle to the users probably.

***Index Terms*—Android mobile, health condition, health care application, IPv6 over low-power radionics personal area network.**

I. INTRODUCTION

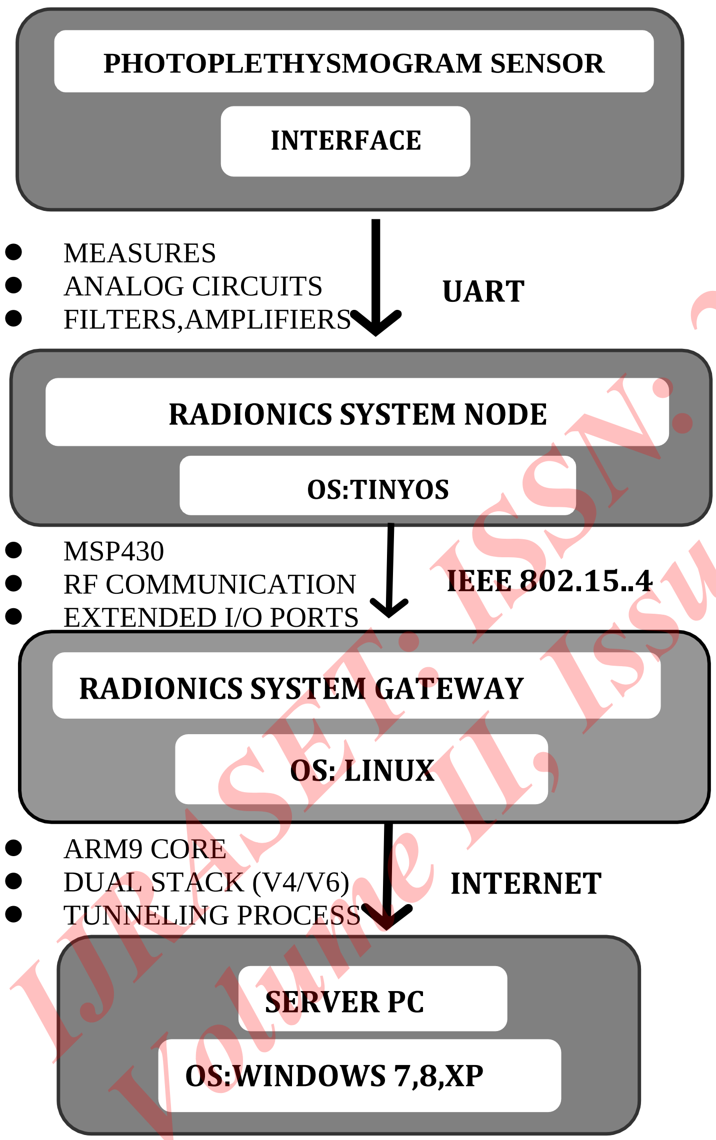
Information and communication technologies are transferring our day-to-day intercommunication, lifestyles and workplaces . The Very most up-coming applications of information technology is health-care and well being management. Health -care is progressive from an proposal based on the susceptive responses to intense conditions to a excited access represented by initial detection, prevention and prolonged management of health condition. The present trend places a attentive on the monitoring of health conditions and the management of well being as significant patrons to individual health-care and well being.This is especially valuable in developed nations with a substantial aging population, where information technology can sensibly progress the management of deep routed situation and thereby improve the aspects of life. Normally, the even occasional recording of bio-medical signals is demanding for the improvement of analysis as-well-as treatment of cardiovascular diseases by using radionics wearable sensors. Example, continuous recording of an electro-cardiogram / photo plethysmogram by a wearable sensor can afford a sensible view of the heart condition of a patient during normal daily routines, and can help to diagnosis such conditions as high blood pressure, stress, anxiety, diabetes, and depression. In addition, it is believable that further automated analysis of recorded bio-medical signals could promote doctors in their daily practices and allow the growth of warning systems. This would deliver several benefits: it would raise the health, associated among doctors, and doctor-to-patient adaptability. Moreover, such continuous monitoring would increase early detection of abnormal health conditions and diseases, and therefore provide a great potential to improve the quality of life of patients [8].Recent professional advancing in systems together with the rise of communications over wired and wireless networks permits the design of weightless, low-power sensors at low cost for wearable sensors ,ICs, and wireless communication and technologies [9], [10].

At its initiation the future of device communication was ambiguous at that time, engineers were just beginning to determine how to absolutely connect cellular technology to other computer systems. In spite of ,with the exciting infiltration of embedded devices, these communications became a effective communication archetype in many appliances that establish on data commutation among devices to make these devices astute in a confined sense and among currently networked applications and services, whose bottom line is the intelligent interplay of machines in a broad sense [11], [12].As a prime accommodating

ISSN: 2321-9653

INTERNATIONAL JOURNAL FOR RESEARCH IN APPLIED SCIENCE AND ENGINEERING TECHNOLOGY (IJRASET)

of these new designs, IP-based wireless networks have been a motivation for increased modernization in devices services, as they have aided in the description of unseen growth circumstances in devices services. The evolution of radionics systems create with the improvement of a wireless sensor network with the help of an IPv6 approach[13].Advances in these networks admit the formation of wireless sensor networks by the adequate addressing mechanism of IPv6 over the IEEE 802.15.4 archetype to every node to improve the quality of data transmission and extend health-care service coverage [14],



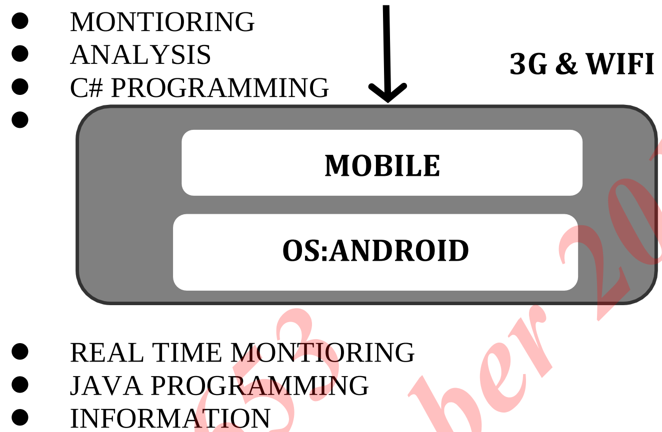


Fig .1. Block diagram of overall system archetype

[15].With advancement in mobile communication, new favorable circumstances have opened up for the improvement

TABLE .1
SPECIFICATIONS OF RADIONICS DEVICES

Module	Item	Specification
PPG sensor	LED	940 nm Infrared
	Gain	100 (20 dB)
	Cut-off Frequency	0.5–10 Hz
	Power	3.3 V
M2M node	MCU	MSP430 (16 bit)
	OS	TinyOS-1.x/2.0
	RF Interface	IEEE 802.15.4
	RF Controller	TI (Chipcon) CC2420
	Data Rate	250 Kb/s
M2M gateway	Power	AC 220 V / DC 3 V
	CPU	S3C2410 (ARM9 Core)
	OS	Embedded Linux
	Network Interface	802.3 10 Mb/s, 802.11 b/g Wireless LAN
	RF Controller	TI (Chipcon) CC2420
	I/O Interface	RS-232, USB 2.0
	Power	DC 5 V
Android mobile	CPU	ARM Cortex 1 GHz
	OS	Android 2.3.6
	Connectivity	Wi-Fi, Bluetooth
	Battery	Li-pol 1.5 Ah

of health-care systems that ca usually monitor bio-medical signals from patients. The possibility of a new creation of mobile

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phones has had an substantial collision on the evolution of such health-care systems, as they smoothly continuous integrate with a wide variety of networks,and thus enable the communication of recorded bio-medical signals to doctors or patients from a basic server located in a hospital, home, or office [16].A smart phone presents a programmed which displays the platform for health-care as people go about their daily lives [17].It is now achievable to conclude a range of behaviors on a phone in real-time,acknowledging users to receive data in reaction to everyday lifestyle choices that empower them to excellence take over to their health.This paper illustrate a wireless radionics device health-care solution that uses Android mobile devices in a global network.The use of a global radionics network in health-care applications assurance to change the use of classical health-care systems based on radionics sensor networks,produced ease of measurement,enlargement of network,convenience,and reliability.The proposed system also expects to help advance the increases of health-care service analysis by affording adept basis for IPv6 through low-power wireless personal area network and mobile technology in wide areas.

II. SYSTEM DESIGN

The overall prototype of a radionics health-care system for the observing of a patient's health state accordant to the pliable and extensible requirements of the IVP6 over Low-power radionics personal area network and mobile computation is shown in Fig.1.

TABLE. II

IP- ADDRESS

Item	Assigned IP Address
Server PC	IPv4: 82.124.184.144 (public)
	IPv6: 2002:527c:b890:: 527c:b890
M2M gateway	IPv4: 192.168.0.155 (global)
	IPv6: 2001:2b8:ee:1::1
M2M node	IPv6: 2001:2b8:ee:100:22:ff:fe00:5
	Prefix IPv6: 22:ff:fe00:0

A. Radionics Health-care Devices

As the root hardware system in the proposed article, the radionics devices are implement to graduate and broad cast the PPG signals in a radionics health-care system, as shown in Table I. The photoplethysmogram(PPG) sensor is designed to attain the PPG signals and datas and oxygen saturation data through patient's finger by manipulating the red and infrared light ratio on the hardware surface, which turn on the assimilation of both class of light. The PPG sensor includes an analog signal process, amplifiers, filters, and analog-to-digital converters (ADCs).Where as the basic fresh signals are too weak and corrupted , signal processing is initially need.The basic signals inquire a filter of low-pass of 24 Hz for the decline of high-frequency noise and a band-pass filter of 0.5 Hz to 10 Hz for the refusal of a DC element to amplify the AC component.The filtered signals are assembled into the micro controller of an device node through an UART port accommodating the sampled PPG signals at 75 Hz [18]. The devices nodes related to the wearable sensors are established on patient's body and are primarily accountable for gathering and transmitting the sampled signals at approximately equal to 75 Hz for the PPG signals to the device port. These nodes linked to the wearable sensors are located on the patient's body in order to receive and transmit health parameters such as ECG signals,PPG signals, and an oxygen saturation value and transmit the received datas to the server for monitoring and examination and determination.The gateway of the device is placed between an IPv6 over IEEE 802.15.4 network and an IP network.The system gateway accomplishes global address interpretation to 16-bit short addresses or IEEE EUI64-bit extended addresses [19]. A Tiny-OS-based system node is appropriated its own IP address by the devices gateway over IPv6 packets.Particularly,the IPv6 over Low power Radionics area network protocol stack is assembled on top of the IEEE 802.15.4 layer in the system nodes for the transmission of packets coordinating to a higher-level protocol, namely, the ipv6 over low-power Radionics ad hoc on-demand distance vector routing protocol detailed by the IETF group [20].

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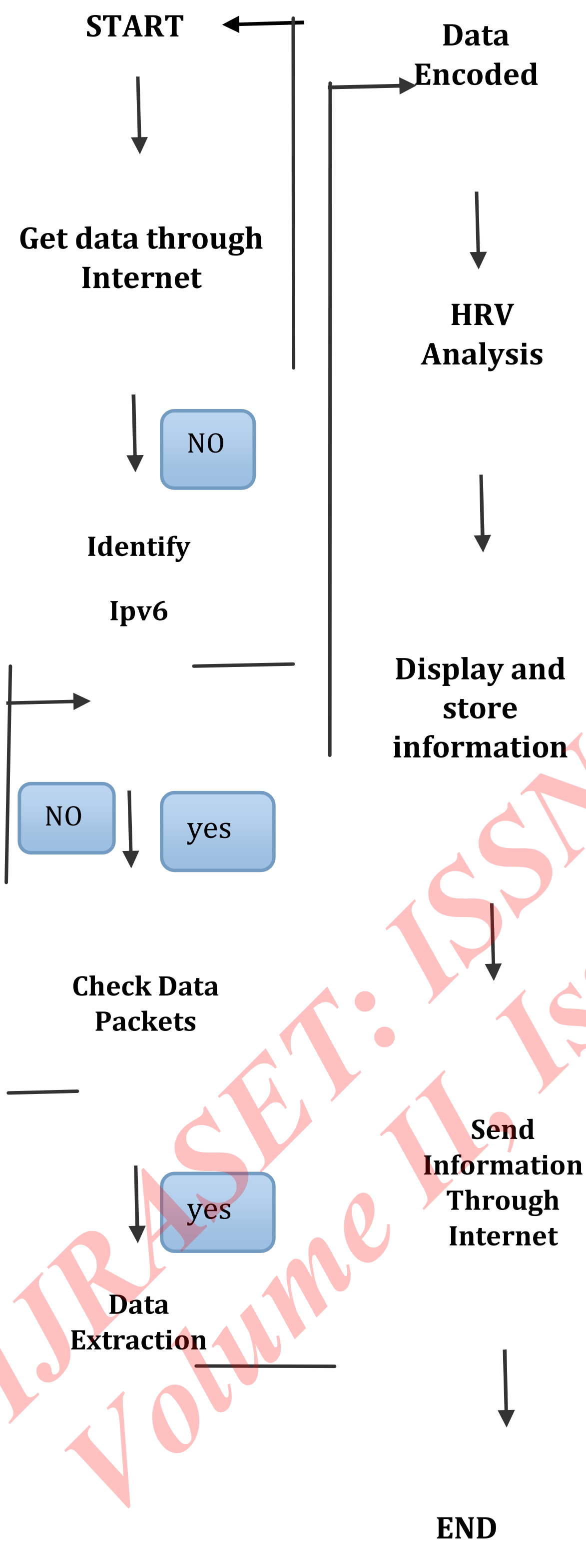

Fig .2. Flow diagram for data processing in the server

B. Ipv6 Over Low Power Radionics Devices

The 6LoWPAN is a new try at overlying an Ip based sensor network atmosphere at various local coverage areas for health-care applications with the IPv6 medium.Therefore, external hosts directly broad cast with the system nodes because each node is determined a global IPv6 address, thereby advocating higher approachable and epoch making network continuation.The proposed system is made up of local gateways in contrasting places with various IP addresses.First, the IPv6 address and the system gateway address must be characterized at the system gateway and server for the IPv6 communication. As the IP network can be normally acquired by IPv4 addresses, the IPv6-to-IPv4 tunneling process, which alternates the address format in the system gateway, is necessary for it to be attainable to approach the server PC through the internet. In this apparatus, the IPv6 address 2002:527c:b890::527c:b890 is convinced to the IPv4 address 82.124.184.144 by the IPv6-to-IPv4 tunneling process, and is then assigned to the server PC. The devices gateway is assigned the IPv6 address 2001:2b8:ee:1::1 (converted to the IPv4 address of 192.168.0.155) to assigned a lower prefix address to the connected system nodes as a 2001:2b8:e e:100:22:ff:fe00:5 in the IPv6 over Low power Radionics area network by auto-configuration function, as shown in Table II.

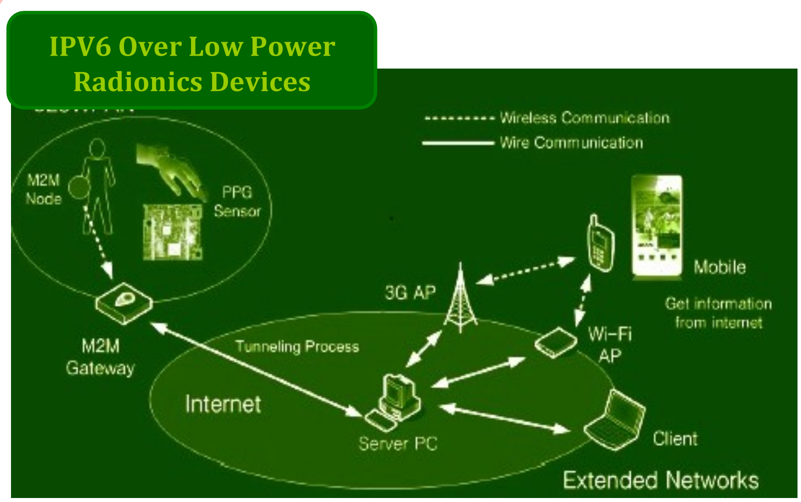

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Fig.3.System Prototype of radionics health care device

C. Android Mobile Device with Server

The measured bio-medical signals are transmitted to the server PC via internet by using the system gateway for advances execution.The monitoring, examination and determination program, written in the C# programming language, stores on the monitors and processes the received data in the server PC, as shown in Fig. 2.Erstwhile a data packet has been received through the devices, the packet is treated,and useful data is abstracted.When the data is received, an IPv6 address is recognized first to establish that the accumulated data has been sent from the correct radionics device source. Then, the data is scanned to establish the data packet is a complete packet. This program gradually monitors not only bio-medical signals, such as the PPG signals and oxygen saturation data secured by wearable sensors.Further, it transmits the received data to the Android mobile device to sustain the mobile health-care monitoring system radionics after diagnosis of Emulator.The mobile monitoring program was implemented and executed on the Android mobile device [21] operating a 1 GHz ARM processor and Android OS version 2.3.6.

III. EXPERIMENTAL RESULTS

Practical tests have been regulated to criticize the real time performance of the wireless health-care system, as shown in Fig. 3. In particular, an experiment was transported out in which one of the authors cover a wearable sensor on his wrist to carry out real-time monitoring for 10 minutes. The node, which is associated to the wearable sensors placed on the patient’s body to accumulate health parameters, further transmits the data to the system gateway. The system node stores the measured datas in a buffer. Each PPG waveform utilize 25 bytes of data packets. The total 29 bytes of a IPv6 over low power radionics area network packet,other than the header, are covered in the payload: 2 bytes for the node ID, 2 bytes for the sensor type, and 25 bytes for data. The gateway is the medium between the IPv6 over low power radionics area sensor network and the internet that receives the packets composing the PPG signals.The system gateway afford stable IPv6 intercommunication to transmit a patient’s bio-medical signals to a doctor or server through the internet.Promoting IPv6 with the IEEE 802.15.4 standard is a ad hoc match of the two technologies.

This program carry out an authentic identification even if the patient is absent minded.Accepting all the transmitted packets through user data gram protocol (UDP) communication in the server, the program stores its data in a database and designs all the steady bio-medical signals energetically. Different algorithms are linked and executed as mobile application software with the Java Android language to handle all the proceeding from the server. The examine processes work outs the communication between the server and Android mobile device to visualize the bio-medical signals graphically on a mobile screen in real time.The recognizing program also demonstrates the records of sensing datas and compatible personal information, such as a PPG waveform display and heart rate, the IPv6 address of the system node, the IPv6 address of the system gateway, the server IP, and buttons for the initiation and termination of a monitoring moment, as shown in Fig. 4. This program is also available to a

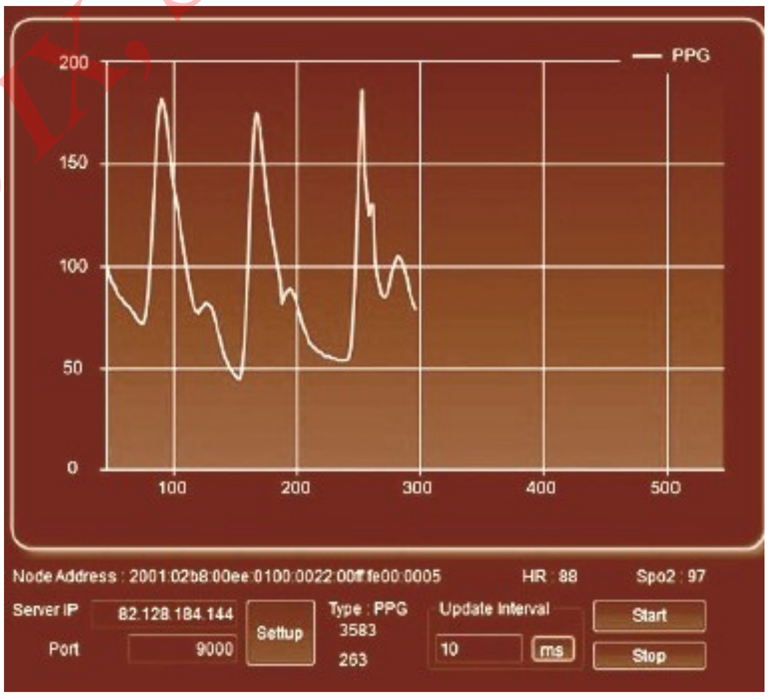

Fig. 4. Screen capture of the monitoring program on the server.

ISSN: 2321-9653

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user PC with an IPv4 address. The server PC can contribute the steady signals with any internet-connected user. All the transmitted data are secured for further monitoring examine and

TABLE III.

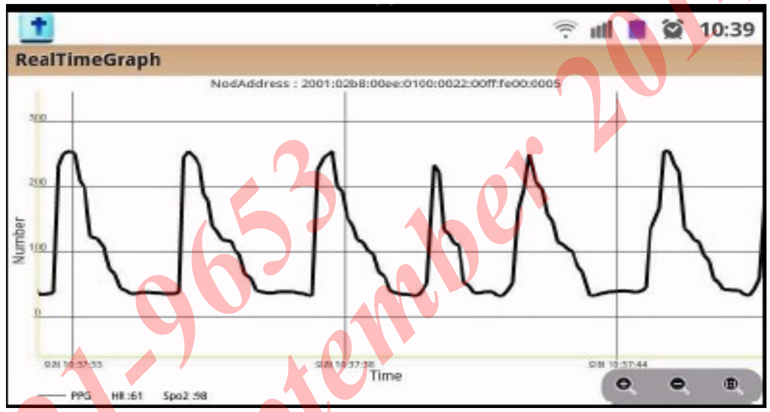
Examination and determination of HRV Analysis

Parameter	Normal	Stressed
Time-Domain analysis		
HR (bps)	78.2 ± 1.49	73.2 ± 0.14
HRV (ms)	769.2 ± 28.6	821.9 ± 13.3
SDNN (ms)	47.2 ± 4.2	33.5 ± 3.9
RMSSD (ms)	38.3 ± 3.8	23.9 ± 2.9
Frequency-Domain analysis		
LF (ms2)	319.98 ± 26.95	246.42 ± 11.27
HF (ms2)	128.43 ± 18.30	70.72 ± 21.68
Ratio of LF/HF	2.49 ± 0.11	3.63 ± 0.95

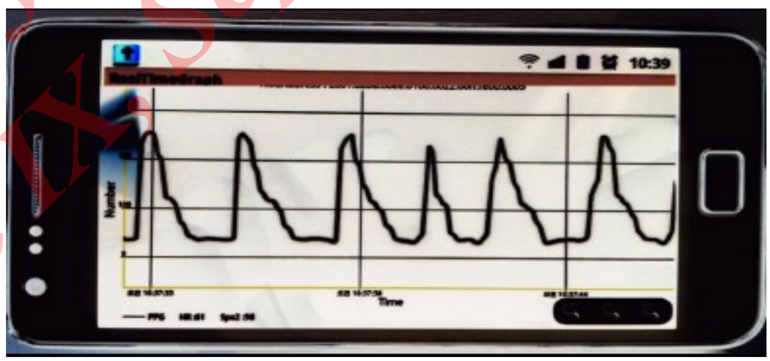
determine. Initially,to promote the health-care service, the heart rate variability (HRV) analysis in the time and frequency domains extracted from the PPG signals – defined as the constant and alters the duration between the heart rates is operated on the server for the intention of efficiently monitoring the patient's health condition The HRV is systematized especially by the autonomic nervous system (ANS) as an indicator of an individual's potentials, which elucidate the nerves scrutinize with the balancing of bodily functions without discretion or consciousness.The ANS is predominant by sympathetic and parasympathetic nerves – sympathetic nerves motivate the heart, expanding the heart rate (HR), and parasympathetic nerves lower the heart rate [25]–[28].

(a)

By correctly calculating HRV signals on the server, the recognized variation can be used to adjudicate the psychological and physiological stress and fatigue on the body. Two test subjects (male, 28 and male, 32) without any heart ailment were recruited for a 10-minute short-term diagnosis and a one hour long-term diagnosis.Subjects were demand to



(b)



(c)

Fig. 5. Monitoring application on an Android mobile. (a) Start mode.(b) Monitoring mode. (c) Appearance of the Android mobile during monitoring overwork and feel lethargic to arrive a mentally and physically stressed state. For the investigation of HRV signals in the time domain, the parameters of mean HR, standard deviation normal to normal (SDNN), and root mean square of successive differences (RMSSD) were explained to valuate the health state in normal and stressed condition.The correlation of SDNN and RMSSD was moderately established to demonstrate the distinct pattern between the normal and stressed states. The frequency domain analysis, which apply the need of

ISSN: 2321-9653

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the power spectrum density (PSD) method to illustrate how power delivers as a function of frequency, simultaneously illustrates the expectation of mental state associated with stress.Three important spectral components are needed for spectrum power indicator determination very low-frequency (VLF), low frequency (LF), and high-frequency (HF) components, which are normally acquired via the PSD analysis in absolute values of power.

The appearance of LF and HF power components give priority to the reserved and balanced behavior of the two branches of the ANS and is with the absolute values of the total LF and HF power components. In Table III, the contrasting of mean values of HRV typical in the time and frequency domain are shortened [19].furthermore to provide the mobile monitoring service,monitoring tests are necessary by use of the Android emulator in the server before establishment on the mobile device.The Android software development kit (SDK)afford emulators that can mimic a numerous of Android versions, screen measures and phone attitudes.Even though the emulator runs a bit easier than a real phone, it transfer sufficient support for all the features and life-cycle events, including persistent state and writing local files, and launches automatically from Eclipse. As shown in Fig. 5, the Android emulator tests have been conducted for the monitoring application using the measured PPG signals.

IV. CONCLUSION

A Radionics health-care solution using the Android mobile devices is successfully executed in a global network with the help of the IPv6 technology. The radionics devices are implemented and applied for the scaling of PPG signals and their transceiver process to a server PC through the IP-enabled internet, while the Android mobile device is used to afford a mobile health-care service with an Android application running on a Samsung Galaxy S device with radionics internet access.By combining the IPv6 over low power radionics area networks and mobile communication techniques,significant network extension with the higher accessibility of devices has been accomplished. We have intended the key ideas of locating the ipv6 over low power radionics devices and the efficient support of IPv6 with the IEEE 802.15.4 protocol in health-care applications. With the use of comfortable wearable sensors in global areas, the proposed health-care system promises to growth the reliability and scalability of health-care applications. In addition, an Android mobile health-care application can be employed on mobile devices, such as smart phones,tablet PCs, and laptops are also used to monitor bio-medical signals in real time for health-care services.

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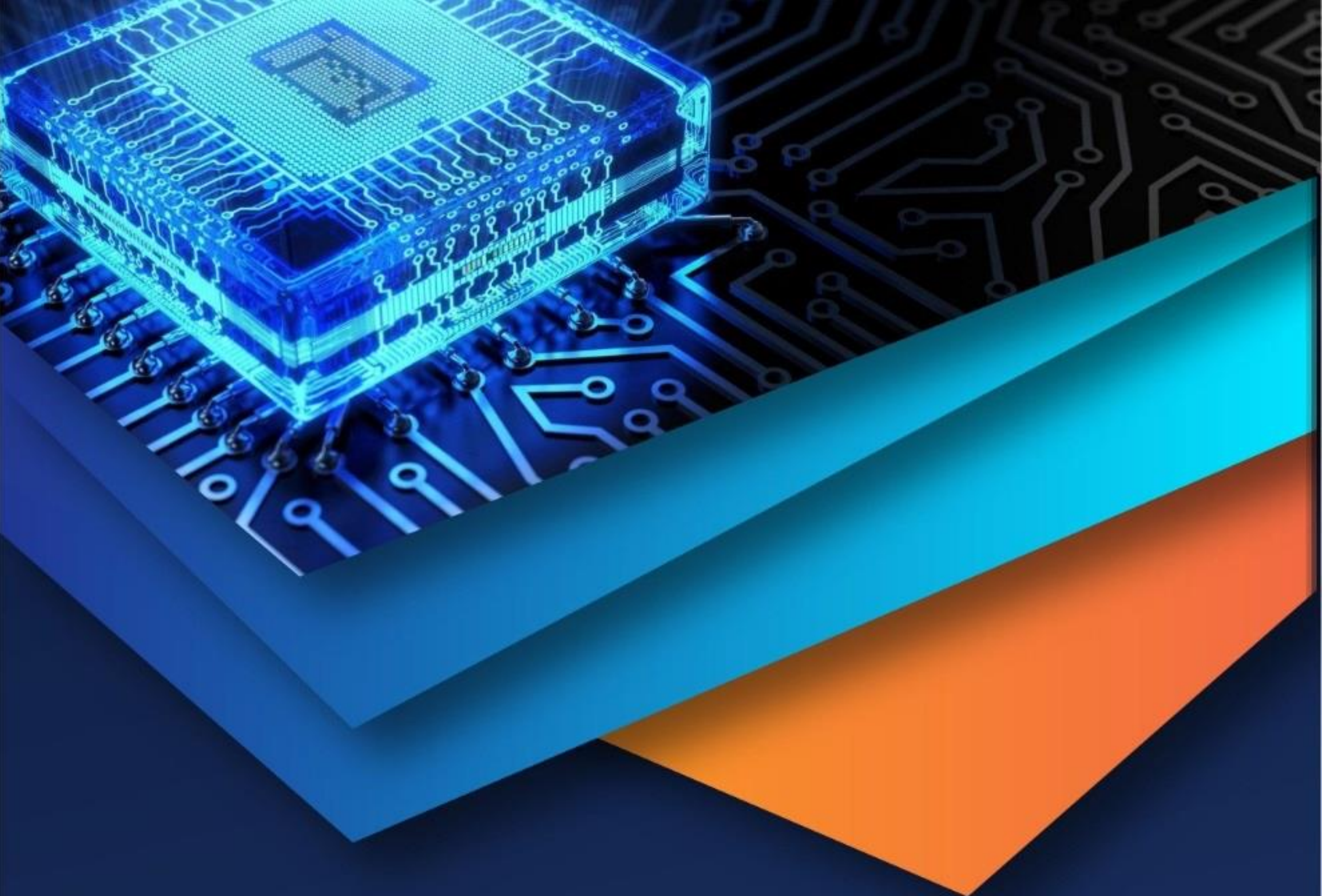

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