© 2014 IJEDR | Volume 2, Issue 1 | ISSN: 2321-9939

Advanced Health Monitoring and Receiving Using Smartphone in Global Networks

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***Abstract* - A healthcare solution that combines android mobile and IPv6 techniques in a wireless sensor network to monitor the health condition of patients and provide a wide range of effective, comprehensive, and convenient healthcare services by using global network. With advances in mobile communication, new opportunities have opened up for the development of healthcare systems that remotely monitor biomedical signals from patients. In this different type of sensors can be used to measure body level of patient in different location such as heart rate, blood pressure, haemoglobin, temperature. Visualization module of the server program graphically displays the recorded biomedical signals on Android mobile devices used by patients and doctors at the end of the networks in real-time. These data's can be transmitted through the Bluetooth, which is received by the smart phone in another location. With the help of GSM we can access human body level from anywhere. A low-power embedded wearable sensor measures the health parameters dynamically and is connected according to the concept of IPv6 over low-power wireless personal area network to the M2M node for wireless transmission through the internet or external IP-enabled networks via the M2M gateway.**

***Index Terms*- Android mobile devices, global network, health condition, health care application.**

I. INTRODUCTION

Information and communication technologies are transforming our social interactions, lifestyles, and workplaces. One of the most promising applications of information technology is healthcare and wellness management. Healthcare is moving from an approach based on the reactive responses to acute conditions to a proactive approach characterized by early detection, prevention, and long-term management of health conditions. The current trend places an emphasis on the watching of health conditions and the management of wellness as significant contributors to individual healthcare and well being. This is particularly important in developed countries with a significant aging population, where information technology can significantly most improve the management of chronic conditions and thereby improve quality of real life. In particular, the continuous or even occasional recording of biomedical signals is critical for the advancement of diagnosis as well as treatment of cardiovascular diseases by using wireless wearable sensors[3]. For example, continuous recording of an electrocardiogram (ECG) or photoplethysmogram (PPG) by a wearable sensor can provide a realistic view of the heart condition of a patient during normal routines daily, and can help determine such conditions as high blood pressure, stress [4], anxiety, diabetes, and depression [5], [6]. In addition, it is conceivable that further automated analysis of recorded biomedical signals could support doctors in their daily practices and allow the development of warning systems. This would bring several advantages: it would increase the health observability, collaboration among doctors, and doctor-to-patient efficiency [7], and thereby decrease healthcare costs. Moreover, such continuous monitoring would increasing early detection of abnormal health conditions and diseases, and therefore provide a high potential to improve the quality of life of patients [8]. Recent technological advances in M2M systems together with the rise of M2M communications over wired and wireless links allow the design of lightweight, low-power sensors at low cost for wearable sensor networks, integrated circuits, and wireless communication [9], [10]. At its inception, the future of M2M communication was uncertain at that time, engineers were just beginning to learn how to directly connect cellular technology to other computer systems. However, with the dramatic penetration of embedded devices, M2M communication paradigm in many applications that concentrate on data exchange among machines to make these machines intelligent in a narrow sense and among currently network applications and its services, whose core is the intelligent interaction of machines in general sense [11]-[12]. A prime benefit of these new strategies, IP-based wireless networks have been a catalyst for accelerated introduction in M2M services, as they have assisted in the identification of hidden growth opportunities in M2M services. The evolution of M2M systems began with the development of a wireless sensor network with the help of an IPv6 technique [13]. Advances in M2M networks allow the establishment of wireless sensor networks by the efficient addressing mechanism of IPv6 over the IEEE 802.15.4 standard to every node to enhance the quality of data transmission and extend healthcare service coverage [14], [15]. With advances in mobile communication, new opportunities have opened up for the development of healthcare systems that remotely monitor biomedical signals from patients by using global networks.

The availability of a new generation of mobile phones has had an important impact on the development of such healthcare systems, as they seamlessly integrated with a wide variety of networks (such as 3G, Bluetooth, wireless LAN, WCDMA and GSM), and thus enable the transmission of recorded biomedical signals to doctors or patients from a central server located in a hospital, home, or office [16]. A smartphone presents a programmable monitoring platform for healthcare as people go about their daily lives [17]. It is now possible to infer a range of behaviors on a phone in real-time, allowing users to receive feedback in response to everyday lifestyle choices that enables them to better manage their health of patients.

II. II.M2M DEVICES

As the core hardware devices in the proposed system, the M2M devices are designed to measure and transmit the PPG signals in a wireless M2M healthcare system. The PPG sensor is designed to obtain the PPG waveforms and oxygen saturation data from a patient's finger by calculating the ratio of red and infrared light on the hardware surface, which depends on the absorption of both types of light.

The PPG sensor contains an analog signal process, amplifiers, filters, and analog-to-digital converters (ADCs). Since the raw signals are too weak and distorted, signal processing is initially required. The raw signals require a low-pass filter (24 Hz) for the reduction of high-frequency noise and a band-pass filter (0.5 Hz to 10 Hz) for the rejection of a DC component to enhance the AC component. The filtered signals are gathered into the microcontroller of an M2M node through an UART port containing the sampled PPG signals at75 Hz [18]. The M2M nodes connected to the wearable sensors are placed on patient's body and are mainly responsible for collecting and transmitting the sampled signals at 75 Hz for the PPG signals to the M2M gateway.

The spo2 sensor can be used in this system to detect pulse rate. It is placed on a thin part of the patient's body, usually a fingertip or earlobe, or in the case of an infant, across a foot. Light of two wavelengths is passed through the patient to a photo detector.

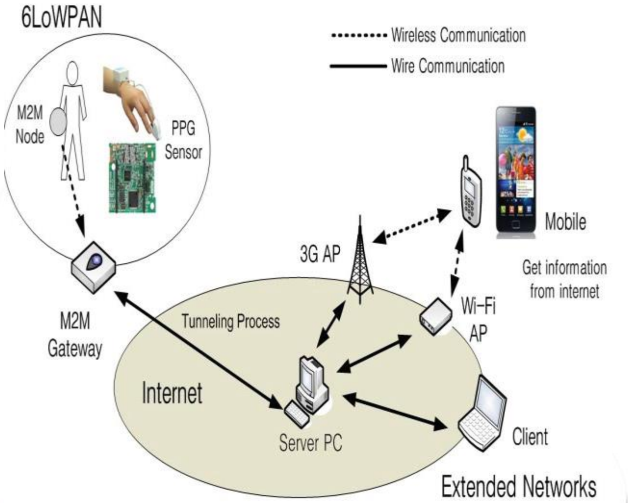

Fig. 1 system architecture of M2M healthcare system

Temperature sensor is used to measure the temperature of the patient and this signal is also given to ADC. The ADC is used to analog signal is converted to the digital signal. [18]That signal is given to the embedded system. Heart beat sensor is designed to give digital output of heat beat when a finger is placed on it. When the heart beat detector is working, the beat LED flashes in unison with each heart beat. This digital output can be connected to microcontroller directly to measure the Beats Per Minute (BPM) rate.

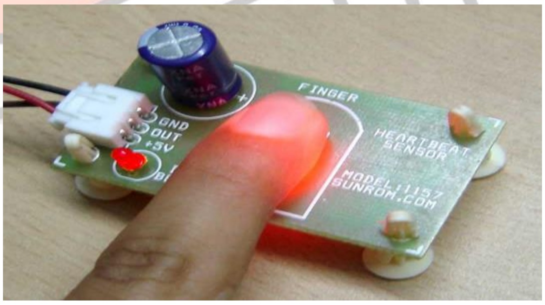

Fig. 2 Heart Beat sensor

The M2M nodes connected to the wearable sensors are placed on the patient's body in order to collect health parameters such as ECG signals, PPG signals, and an oxygen saturation value and transmit the collected parameters to the server for monitoring and analysis[1]-[3]. The M2M gateway is placed between an IPv6 over IEEE 802.15.4 network and an IP network. Moreover, the M2M gateway performs global address translation to either 16- bit short addresses or IEEE EUI64-bit extended addresses [19]. A Tiny OS-based M2M node is allocated its own IP address by the M2M gateway over IPv6 packets. In particular, the 6LoWPAN protocol stack is implemented on top of the IEEE 802.15.4 layer in the M2M nodes for the transmission of packets according to a higher-level protocol, namely, the 6LoWPAN ad hoc on-demand distance vector routing protocol developed by the IETF group [20].

III. ANDROID SDK TOOLS

The Android software development kit (SDK) includes a comprehensive set of development tools. These include a debugger, libraries, a Handset emulator base on QEMU, documentation, sample code, and tutorials. Currently supported development platforms include computers running Linux (any modern desktop Linux distribution), Mac OS X 10.5.8 or later, Windows XP or later; for the moment one can develop Android software on Android itself by using AIDE [Android IDE -

Java, C++] app and Android java editor app. The officially supported Integrated Development Environment (IDE) is Eclipse using the Android Development Tools (ADT) Plug in, though IntelliJ IDEA IDE (all editions) fully supports Android development out of the box, and Net Beans IDE also supports Android development via a plug in. Additionally, developers may use any text editor to edit Java and XML files, then use command line tools (Java Development Kit and Apache Ant are required) to create, build and debug Android applications as well as control attached Android devices (e.g., triggering a reboot, installing software package(s) remotely).

Enhancements to Android's SDK go hand in hand with the overall Android platform development. The SDK also supports older and new versions of the Android platform in case developers wish to target their applications at older devices. Development tools are download components an tools for new and older version, and it will used for testing. Android applications are packaged in .apk format and stored under /data/app folder on the Android OS (the folder is accessible only to the root user for security reasons). APK package contains .dex files (compiled byte code files called Dalvik executables), resource files, etc. The system architecture as shown in fig3.

TABLE I
SPECIFICATIONS OF M2M 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

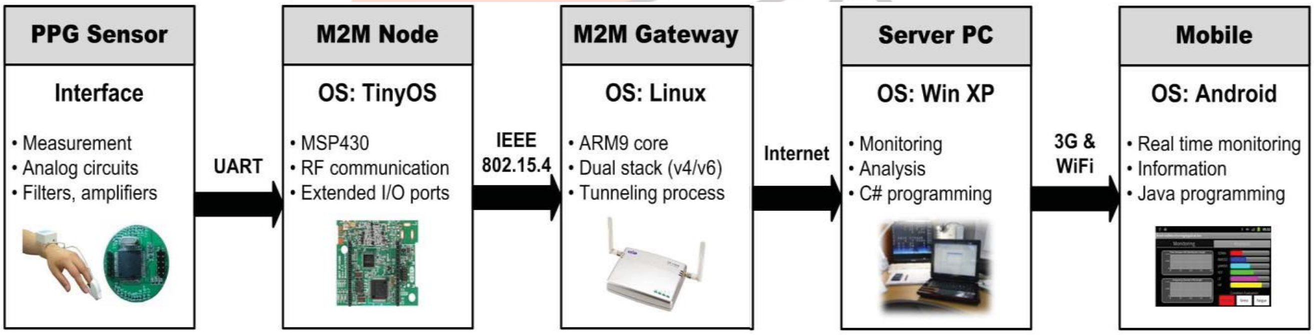

Fig.3 Block diagram for system architecture

IV. HYPERNEXT ANDROID CREATOR

Hyper Next Android Creator (HAC) is a software development system aimed at beginner programmers that can help them create their own Android apps without knowing Java and the Android SDK. It is based on HyperCard that treated software as a stack of cards with only one card being visible at any one time and so is well suited to mobile phone applications that have only one window visible at a time. Hyper Next Android Creator's main programming language is simply called Hyper Next and is loosely based on Hyper card's Hyper Talk language. Hyper Next is an interpreted English-like language and has many features that allow creation of Android applications. It supports a growing subset of the Android SDK including its own versions of the GUI control types and automatically runs its own.

V. DEVICE AND ANDROID MOBILE

The measured biomedical signals are sent to the server PC through the internet by using the M2M gateway for further processing. The monitoring and analysis program, written in the C# programming language, monitors, stores, and processes the received data in the server PC[19]. Once a data packet has been received through the M2M devices, the packet is processed, and useful data is extracted. When the data is received, an IPv6 address is identified first to ensure that the aggregated data has been sent from the correct M2M device source. Then, the received data is scanned to ensure the data packet is a complete packet. This program continuously monitors not only biomedical signals, such as the PPG signals and oxygen saturation data acquired by wearable sensors, but also information related to M2M devices[19], such as communication settings and IPv6 addresses, in real-time. Further, it sends the received data to the Android mobile device to support the mobile healthcare monitoring system wirelessly after emulator testing. The mobile monitoring program was implemented and tested on the Android mobile device (Samsung Galaxy S,Korea) [21] running a 1 GHz ARM processor (Cortex A8,Hummingbird) and Android OS version 2.3.6. Through the wired or wireless internet, the server is able to connect to different types of mobile devices and various development testing can be performed on it.

VI. SIMULATION OUTPUT

The below figure shows the android emulator display after configure the program

Fig. 4 Emulator Display

Figure 4 shows the result of Android Application which includes username and password. With the help of this account we can save our database and used for future references.

Figure 5 shows the display of sensor level. By using this we can measure the health condition of patients through Android mobile Health monitoring Activity of Android Application working in an Android emulator

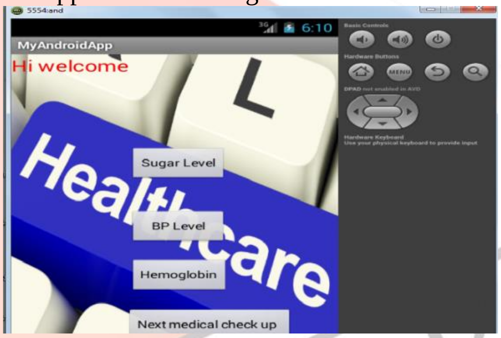

Fig.5 Display of sensor level

Figure 6 shows the Blood Pressure display of patient level. By pressing the button of each level, it shows the health condition of patient.

Fig. 6 Display of BP Level in Emulator

VII. CONCLUSION

For the remote health monitoring of the patient, An application program has been developed. In that application media contents also included. The Android application is also implemented on a Tablet PC. It works properly in the phone. The future works to done are communication of sensors with the M2M node and data transmission of sensors through M2M node to server PC and the Android application developed.

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