Wearable Health Monitoring System Based on Smartphone Application

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Abstract— This paper aims at wearable health monitoring system based on mobile phones. Mobile computing is popular as wireless network has been deployed almost everywhere. Smart phones contain powerful embedded sensors such as GPS, accelerometer, digital compass, gyroscope, microphone and camera. A wearable health monitoring system based on mobile phones may reduce cost of healthcare and simultaneously improve the quality of healthcare. Smartphone equipped with large screen, open operating system and powerful memory are increasingly used in many healthcare applications.

Keywords— wearable health monitoring system, wireless network, wireless sensor, Smartphone.

I. INTRODUCTION

Heavy daily work and lack of exercise increases stress and real time monitoring of stress situation becomes more important [1]. Lifestyle changes effect on personal health and cause wide range of health related problem like blood pressure, stress, anxiety, diabetes and depression. Mobile health care is to develop new technology that can assist individuals in maintaining a healthy lifestyle [1][2]. Smart phones embedded with a wide variety of sensors are enabling a new generation of personal health applications that can actively monitor, unbalanced unhealthy lifestyles present in the general population.

In present life style, cell phone is one of the prominent parts of life style, for contacting each other via text and voice. Inside, it has more facilities such as check mail, play game, send and receive file, etc. that allows the user to have access to more services. Mobile phones that perform many of the operations, called smart phones, can work with different kind of applications depending on their operating systems [3]. Today, smart phones are equipped with devices that are used in many different sectors such as business, healthcare, social networks, environmental monitoring, safety, and transport. For enabling related application to consider different domains, a set of embedded sensors such as accelerometer, compass, gyroscope, GPS, microphone, and camera are directly included in smart phones [3]. In addition, the popularity of smart phone application stores (e.g., the apple app store, android market) has opened an effective software delivery channel. Smartphone are becoming increasingly popular because of their capabilities and functionalities. Their small size and light weight make them very easy to carry, and they provide useful services as they run PC-like applications [4].

II. INTRODUCTION TO SMART PHONE

Smart phone has open operating systems, such as Palm OS, Windows Mobile, Symbian, and Linux and scalable hardware-software multi-function [5]. Mobile phones and other wireless devices are becoming increasingly popular and that world expanded tremendously. With the development of information technology, smart phones have become the mainstream in the mobile market and have gradually occupied the market steadily. For getting new features traditional phones are replaced by Smart phones. Smart-phone has several advantages over the traditional mobile phones:

- Keep full functionality of the traditional mobile phones (e.g. phone conversation, text message and so on).
- With the ability of plugging into the Internet.
- It is a kind of cell phone which includes personal information manager, schedule control, multimedia application and internet connection.

It has an open mobile operating system that allows the functions to be expanded to a large extent [6].

A. *Smartphone operation system: Google android*

Android operating system is built on Linux and support many function. Security of android is also based on Linux system. Access control such as user IDs are managed in such a way that each of the installed mobile software gains its own user ID with its own particular permissions [7].

B. *Android features*

- Reuse and replacement of components
- Dalvik virtual machine
- Integrated browser
- Optimized graphics
- Media support
- GSM Telephony
- Bluetooth, EDGE, 3G, and WiFi

- Camera, GPS, compass and accelerometer
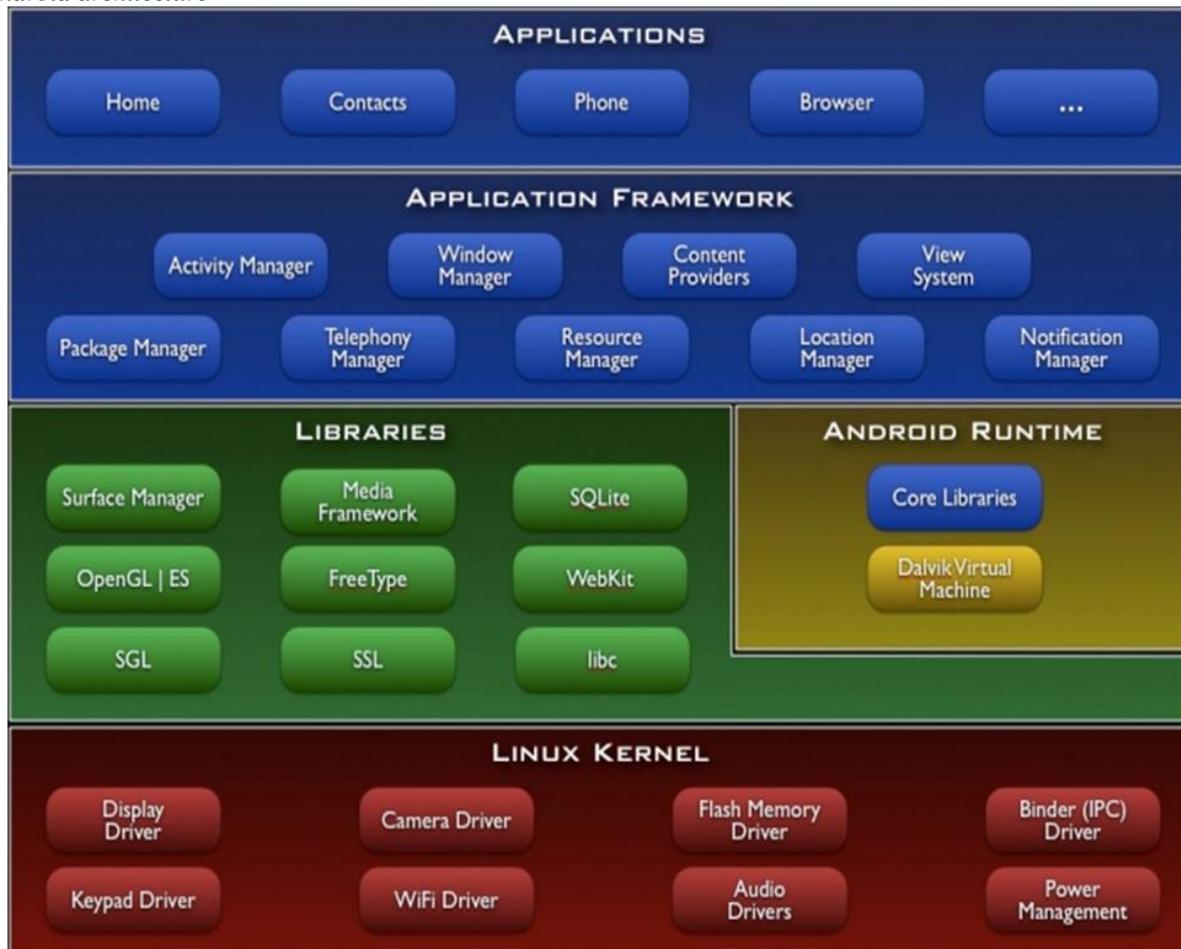- Rich development environment

C. Android architecture

Fig. 1 Android Architecture [13]

Figure 1 shows android system architecture that operates on Linux Kernel. Android is open Source Framework designed for mobile devices and it has powerful Software Development Kit. Libraries layer is developed using c/c++ programming languages. Libraries are packed in Application Framework. Run-time environment consists of core library that provides the functions of Java Language. Linux Kernel provides Memory Management, Process Management and Networking [7].

D. Application Fundamentals

Apps are written in Java bundled by Android Assent Packaging Tool. Every App runs its own Linux Process. Each process has its own java Virtual machine. Each App is assigned a unique Linux user id. Apps can Share the same user ID to see each others' files.

E. Health Apps

The term 'app' stands for a computer application on the mobile device. Apps can be e-books, interactive reference materials, training modules, medical software devices, data collection tools, interactive patient handouts, etc. Health apps help consumers to maintain a healthy lifestyle or offer health-related services. The most popular categories of downloaded health apps are exercise, stress, and diet.

III. MONITORING PHYSICAL ACTIVITY AND STRESS

Stress is the body ability to effectively manage/deal with any given situation whether it is positive or negative. It is your reaction to any stimulus that you cannot deal with. Some people define stress as event or situation that causes them to feel tension, pressure or negative emotion [8].

A. Mobile phone to Web

Using mobile phone, we can monitor physical activity. The phone records and uploads location every few seconds to secure server. Based on these location time traces and also tagging the activities (such as walking, biking, driving, etc.), physical activities can be monitored.

In case of phone mob to web, there is another option for monitoring changes, for instance the participant use their mobile phone to take picture from certain locations and then upload this picture to the web portal. Moreover, mobile phone and web can be used to provide information about behaviours, lifestyle, and medical situation of elders to their family and doctors. Sensing and recording will be accomplished automatically [3].

B. Wearable Sensor to monitor Health

Wearable system consists of three main building blocks:

- Sensing and data collection hardware to collect physiological and movement data.
- Communication hardware and software to relay data to remote centre.
- Data analysis techniques to extract clinically-relevant information from physiological and movement data.

Small version of sensor and electronic circuits, based on use of microelectronics, has played a key role in the development of sensors. Recent development in the field of microelectronics have allowed researchers to develop small circuits enabling sensing capacity, front end amplification, microcontroller function, and radio transmission. Such technology allows one to gather physiological data as well as transmit the data wirelessly. Microelectronics allows integrate other components such as microprocessor and radio communication circuits [10].
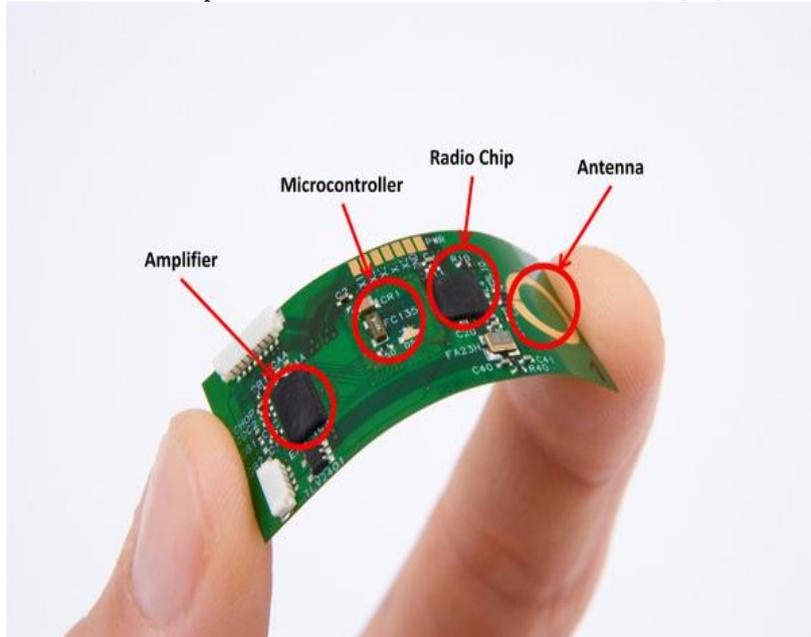

Fig. 2 Flexible wireless ECG sensor with a fully functional microcontroller [10]

C. Droid Jacket

In Droid jacket, sensors are embedded in garment to collect electrocardiographic and electromyography data. The movement data is collected by weaving electrodes into the fabric and by printing conductive elastomeric-based components on the fabric. The movement data is sensed with stretch of garments that causes changes in their resistance. The Vital Jacket aggregates a suite of non-intrusive wearable technologies. It combines textile and microelectronics providing a reliable physiological data for sports activities. Obtaining such data is useful to achieve a realistic physiological assessment of monitored subject. By performing this continuous monitoring, we are able to acquire and gather real time information of body signal. Over last few years, new technological advances in mobile and wireless communication brought novel resources for support of monitoring system. Mobile device such as smart phone that integrates mobility, computational power, friendly interaction capability are being used for monitoring systems. These devices also provide facilities like multi-threading and wireless standard support such as Wi-Fi, Bluetooth, ZigBee. The Droid jacket is an Android based application running on smart phone that gather the vital signs such as ECG stream and relay it on external clients or for healthcare [1].
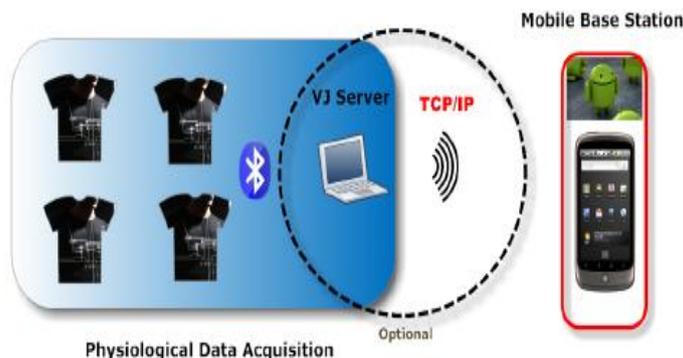

Fig. 3 Droid Jacket Overview [1]

IV. Conclusion

Wearable physiological monitoring systems are intelligent medical monitoring devices, which provide real-time feedback to the wearer or remote monitoring station. Wearable sensors maintain individual data and transmit the same to

a remote monitoring station continuously, where the health status of the individuals is monitored remotely. These systems are capable of monitoring the health status of individuals who perform very high risk jobs like soldiers in a battle field, fire fighters, mine workers, etc. Also, these systems will be useful for monitoring the health status of the elderly people at home. The data collected from the wearer using the wearable physiological monitoring systems should be kept private and during transmission the data should be encrypted and be secured. Continuous monitoring with early detection has likely potential to provide patients with an increased level of confidence which improve quality of life. Stress sense will increase individual's awareness of everyday challenges and help them to better deal with problem resolution.

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