Available Online at www.ijcsmc.com

International Journal of Computer Science and Mobile Computing

A Monthly Journal of Computer Science and Information Technology

ISSN 2320–088X

IJCSMC, Vol. 3, Issue. 4, April 2014, pg.125 – 130

RESEARCH ARTICLE

Mobile HealthCare Technology Based on Wireless Sensor

Pimpre.D.M[1], Bhagat.V.B[2]

Dept. of Computer Science, P.R.Patil College of Engineering & Technology, Amravati, MH, India

dipika.pimpre2@mail.com; mat.vaishali2@gmail.com

***Abstract*—**

The recent advances in Wireless Sensor Networks have given rise to many application areas in healthcare. It has produced new field of Wireless Body Area Networks. Using wearable and non-wearable sensor devices humans can be tracked and monitored. Monitoring from the healthcare perspective can be with or without the consent of the particular person. Even if it is with the consent of the person involved, certain social issues arise from this type of application scenario. The issues can be privacy, security, legal and other related issues. Healthcare sensor networks applications have a bright future and it is a must to take up these issues at the earliest. The issues should be carefully studied and understood or else they can pose serious problems. In this paper we try to raise and discuss these issues and find some answers to them. This paper focuses on WSNs utilization in medicine. In order to present the current state in this research field, few particular projects have been selected and compared.

Key Terms- Wireless Sensor Networks (WSNs); Sensor Nodes; Utilization; Existing Medical Applications (EXMAs); Healthcare

I. INTRODUCTION

Today's home healthcare progression is becoming a predominant form of healthcare delivery Quality and healthy lifestyle includes good support of human health performance monitoring and assessment [1]. Wireless Biomedical Sensor Networks (WBSN) is a collection of wireless network comprising low powered bio-sensor devices known as "motes" or "nodes" i.e., the convergence of bio-sensors using network technology in wireless ambience. In principle, it is an integration of embedded microprocessors, a radio device with limited amount of data storage [3].

Recent development of high performance microprocessor and novel sensing materials has stimulated great interest in the development of smart sensors -physical, chemical or biological sensors combined with integrated circuits

Although the field of biomedical sensors is relatively new, there has been numerous significant works previously where traditional sensor technologies have been applied in making biomedical measurements [5]. This has helped to define the limitations as well as to set new direction for further research.

Wireless Sensor Network (WSN) is a set of small, autonomous devices, working together to solve different problems. It is a relatively new technology, experiencing true expansion for the past decade. Research in the field of nanostructures and sensors has brought real opportunities for development of WSNs. People have realized that integration of small and cheap microcontrollers with sensors can result in production of extremely useful devices, which can be used as an integral part of the sensor nets. These devices are called sensor nodes. Nodes are able to communicate each other over different protocols. Studies, in the field of communication protocols for wireless sensor networks, are particularly interesting, and rely on various network topologies. Issues, addressed by communication among nodes, include power management, data transfer, mobility patterns, etc. Like it was mentioned before, WSNs present

A. Today's healthcare

Nowadays, healthcare system is highly complex. List of elderly people and people in need for continuous care increases every day. Medical staff faces with more and more challenges each year. This opens serious questions in the domain of interest, which must be answered in the best way possible. Problem solving must include detail analyses of the current state in order to form good and functional system which resolves the satisfying number of issues. Wireless sensor networks can offer this kind of solution.

B.WSNs – Existing medical applications (EXMAs)

Existing medical applications based on wireless sensor networks are still research projects with good potential for utilization. Great number of medical scenarios is being covered with these applications and that opens wide spectrum of benefits for caregivers. They should be able to provide the necessary care whether in emergency situations, or in some hospital environments, or in form of smart homes. A lot of effort needs to be done before the EXMAs' ultimate aim is reached. In this case, the ultimate goal implies the improvement of human lives.

Motion and Activity Monitoring Another application domain for WSNs in healthcare is high-resolution monitoring of movement and activity levels. Wearable sensors can measure limb movements, posture, and muscular activity, and can be applied to a range of clinical settings including gait analysis [60], [64],[73], activity classification [29], [52], athletic performance [3], [51], and neuromotor disease rehabilitation [49], [57]. In a typical scenario, a patient wears up to eight sensors (one on each limb segment) equipped with MEMS accelerometers and gyroscopes. A base station, such as a PC-class device in the patient's home, collects data from the network. Data analysis can be performed to recover the patient's motor coordination and activity level, which is in turn used to measure the effect of treatments. In such studies, the size and weight of the wearable sensors must be minimized to avoid encumbering the patient's movement. The SHIMMER sensor platform shown in Fig. 1 measures 44.5 _ 20 _ 13 mm and weighs just 10 g, making it well suited for long-term wearable use. In contrast to physiological monitoring, motion analysis involves multiple sensors on a single patient each measuring high-resolution signals, typically six channels per sensor, sampled at 100 Hz each. This volume of sensor data precludes real-time transmission, especially over multihop paths, due to both bandwidth and energy constraints.

The SHIMMER platform incorporates a MicroSD interface, permitting up to 2 GB of storage Venough to store up to a month of continuously sampled sensor data. While the energy consumption of flash input/output is non-eligible, it is about one-tenth the energy cost to transmit the same amount of data over the radio. As a result, it is necessary to carefully balance data sampling, storage, processing, and communication to achieve acceptable battery lifetimes and data fidelity.

Two systems, SATIRE [23] and Mercury [49], typify the approach to addressing these challenges. SATIRE is designed to identify a user's activity based on accelerometers and global positioning system (GPS) sensors integrated into Bsmart attire[such as a winter jacket. SATIRE nodes, which are based on the MICAz [16] platform, measure accelerometer data and log it to local flash. These data are opportunistically transmitted using the low-power radio when the SHIMMER node is within communication range with the base station. Once the data are collected at the base station, the collected data are processed offline to characterize the user's activity patterns, such as walking, sitting, or typing. Sensor nodes perform aggressive duty cycling to reduce power consumption, extending lifetimes from several days to several weeks.

The goal of the Mercury system is to permit long-term studies of a patient's motor activity for neuromotor disease studies, including Parkinson's disease, stroke, and epilepsy. Energy is far more constrained in Mercury than in SATIRE, due to the use of lightweight sensor nodes with small batteries. Mercury builds upon SATIRE's approach to energy management and integrates several energy aware adaptations, including dynamic sensor duty cycling, priority-driven data transmissions, and on-board feature extraction. Mercury is being used in several studies of Parkinson's and epilepsy patients [49]. While SATIRE and Mercury show the feasibility of using low-power wireless platforms to perform longitudinal studies of human activity, issues related to improving node lifetime and providing stronger security and privacy guarantees remain areas of active research.

C. Accelerometer sensor and geolocation facilities

The main application of accelerometers for healthcare purposes is to track a person's physical activity level. It is important as it allows to reduce the risk of having many chronic diseases. There are specially designed accelerometer-based devices that measure activity level as a number of steps performed by the person. Such devices are called pedometers. To detect steps they capture readings from accelerometers and recognize the step pattern. Some pedometers can also calculate approximate number of burned calories. Recently mobile phones equipped with different embedded sensors have been used in several studies to collect data for activity classification.

II. LITERATURE REVIEW

Review

We summarize the healthcare system as two categories:
1) health mentoring system which is designed for monitoring physical vital signs of patients like blood glucose level, ECG and blood pressure;
2) health support system which is designed to facilitate the people's daily activities like taking medicine timely and completely, exercise and taking healthy food

1. Health monitoring system

Common architectures for health monitoring system Wireless sensor networks (WSNs) and smart phone technology have opened up new opportunities in health monitoring system. The integration of the existing specialized medical technologies with cell phone and wireless sensor networks is a very promising application in home monitoring, medical care, emergency care and disaster response. In the emergency situations, the most important thing is to determine the rapid and accuracy triage of the patients with limited resource. And the real-time and continuous triage information must be distributed to health care providers. Light weight and no intrusive biomedical sensors like pulse dosimeter and electrocardiogram are easy to be deployed for continuously monitoring the vital signs of a patient and deliver the data to the first responders[5][6][7].A mobile architecture for diabetes management Using mobiles with a multi-access service for the management of diabetic patients was proposed in [14] and shown in Figure 3, which was designed to collect data, either manually or automatically from the blood glucose meter; to monitor blood glucose levels; to suggest insulin dose adjustment when needed; to deliver monitoring data to a health care center. Methods User Centric Privacy Access Control for m-Healthcare Emergency when an emergency takes place in m-Healthcare, e.g., user U0 suddenly falls down outside, the healthcare center will monitor the emergency, and immediately dispatch an ambulance and medical personnel to the emergency location. Is closure during the opportunistic computing. Detailed security analysis shows that the proposed SPOC framework can achieve the efficient user-centric privacy access control.
In addition, through extensive performance evaluation, we have also demonstrated the proposed SPOC framework can balance the high-intensive PHI process and transmission and minimizing the PHI privacy disclosure in m-Healthcare emergency. In our future work, we intend to carry on smartphone based experiments to further verify the effectiveness of the proposed SPOC framework. In addition, we will also exploit the security issues of PPSPC with internal attackers, where the internal attackers will not honestly follow the protocol.

III. PROPOSED WORK

This section presents characteristics of the solutions for mHealth. The objective of this section is to provide details about the solutions found in the areas of patient monitoring, infrastructure, software architecture, modeling, framework, security, notications, multimedia and literature review.

3.1 Patient Monitoring

Several of the analyzed studies focus on solutions for monitoring bio-signals. Monitoring is usually done using external sensors that are not built-in to the mobile device. These sensors usually communicate with the mobile device through 4 Jersak et al. Wi-Fi or short-ranged protocols such as Bluetooth or ZigBee (IEEE 802.15.4 standard) [28]. In most cases, the mobile device acts as a gateway that Gathers raw data from the sensors and then forwards it to a separate system that will process it and return data ready for visualization, by doctors or the patient himself. As a rest example, Penders et al. [32] use a smart phone as a gateway to collect bio-signal data from sensors and further presentation of this data to the doctor or patient. Other studies [34], [21], [38] and [18] propose monitoring systems in which the sensor data is gathered by the smart phone and then sent to a remote server for processing and storage. Similarly, the study from Pandey et al. [30] present a system in which the mobile device collects data and sends it to processing in the cloud. Also, the mobile device can retrieve the data from the cloud and show it to the doctor or patient. Likewise, Afonso et al. [1] propose a solution where the data gathered from external sensors by the mobile device is forwarded through a ZigBee link to a computer that acts as a ZigBee-to-Wi-Fi gateway. This computer also processes the data and then sends it to a remote server, where it is stored and can be accessed using mobile devices or the web. Blumrosen et al. [8] presents a solution that gathers the sensor data through a ZigBee network, using the smart phone at rst as a gateway. The data is sent via MMS (Multimedia Messaging Service) to an email box at a remote server for analysis and processing. The data is then sent back to the smartphone so the patient can visualize it. In Ivanov et al. [17] an example of a monitoring application is presented and tested in 11 different smart phones and PDAs. The objective is to check and compare the performance of each device for healthcare applications. Because hardware evolve so quickly, it is hard to keep up-to-date knowledge in this regard. The study from Pereira et al. [33] shows a solution implemented in 4 different operating systems (Android, Symbian, iOS and Windows Mobile). This solution communicates with the sensors via Bluetooth and it is capable of plotting graphs to better show the patients vital signs. Besides, if a vital sign exceeds a certain threshold, the application may do an emergency call.

3.1.1 Closing Remarks on the Monitoring Area

In general, the proposed solutions are implemented for the operating systems Android, iOS and Symbian. Also, the most typical language used for developing mobile applications is Java (J2ME platform). One exception is the solution proposed by Pereira et al. [33], which used Python because it provides better control of the application, according to the authors.

3.1.2 Monitoring Using Sensors

After the analysis of the studies classified under the category of patient monitoring, we found that 12 solutions use some sort of sensor to gather the patient's life signs. It is also important to notice that the sensors built-in to the mobile devices are insufficient to cover the needs of this area. This conclusion was found due to the number of studies that required external sensors for data acquisition. The solutions presented in Panders et al.[32] and in Chi et al. [11] have even developed prototypes for this type of sensors. The sensors found in the analyzed studies were: Electrocardiogram (ECG); Electroencephalogram (EEG); Blood Pressure (BP); Skin Temperature (Tmp); Respiratory Rate (RR); Heart Rate(HR); Accelerometer (Accel); GPS; Luminosity Sensor (Lum); Gyroscope (Gyr).. It is possible to observe that most of the sensors used are not built-in to the mobile devices

3.2 Infrastructure

Heslop et al. [15] presents some interesting endings but it has a downside: it was developed focusing on a restricted area, a specie hospital in Australia. As a consequence, a general implementation for hospitals would probably require adjustments, if feasible.

The authors also mention the benefits of tablets, such as the ease of use and good screen resolution that favors the visualization of certain exams, e.g. radiology images. But they also mention a disadvantage of these devices: the low battery life (about 2.5 hours). This kind of remark is frequent in works

3.3 Software Architecture

In Pawar et al. [31] a generic architecture for comparing patient monitoring applications is proposed. The study was used to compare six deferent monitoring applications, selected according to the following criteria: use of mobile communication technologies, test evidences and scientific publication availability. It was also used to dine the features of real-time epilepsy monitoring systems. A mobile network architecture for clinical use is proposed in [35]. The pro-posed network is split in parts: health agencies, medical clinics, doctors, patients and the application. A scenario of usage of this application is when the patient activates the software in his smart phone and requests medical aid. The health care unit receives the patient's location and sends help from the nearest location. The study presented in Sierra et al. [36] focuses on monitoring systems that use SMS and agents which analyze information and make decisions. Also, it tries to address energy consumption and emergency alerts. Patient data is sent from the sensors to the smart phone via Bluetooth. Heart rate and blood pressure sensors were used for testing the solution.

3.3.1 Closing Remarks on the Software Architecture Area

In many aspects, the architecture and framework areas overlap each other.

Some authors classify their works as architecture with characteristics of framework, but we decided to maintain the author's explicit classification when present. Several studies on architectures were found, including solutions for monitoring specific areas [7].

3.4 Modeling

Only one paper was classed under the modeling area. Gomes et al. [14]only presents a modeling of their proposal for a mHealth software product line, leaving the implementation in a real environment for future work. A drawback of this kind of approach is that it is only possible to estimate how the solution's behavior would be. In other words, real world situations would be more suits able for testing and analysis.

3.5 Software Development Frameworks

The study presented in Ahmed et al. [2] proposes a framework for mHealth data security on Android systems. It is possible to dine which data will be monitored by the framework by conjuring some parameters. When an application running on the patients smart phone tries to transfer monitored data to unknown destination, the user is prompted if she really wants to complete the operation. Lin et al. [23] propose a framework to facilitate the development of applications which communicate with external sensors. The presented framework simpli On the other hand, Mashima et al. [25] proposes accountability techniques for eHealth data, with a patient-centric focus. The main concern assessed in this study is that the patient should know what is being done with his medical data and be informed about it. This study tries to reach three goals: (1) Accountable update: update the patient about changes made in his medical data stored in repository; (2) Accountable usage: inform the patient when his data is used by an entity; (3) Protection of honest entities: this is in the form of protocols that the entities must follow. This also makes the patient able to dispute requests from compromised or dishonest entities.

Another study in Le et al[22] proposes a cryptography scheme for networks for mobile devices in health using public keys and elliptic curve cryptography. The network has special nodes called Key Distribution Centers which are responsible for generating and distributing the keys. After receiving the key, every time advice needs to transfer information to another device in the network, the devices exchange keys and the connection is encrypted. Similarly to the works presented in [25] and [22], Barua et al. [5] proposes cryptography system using public keys to control access to patients data. The system is patient-centric, meaning that the patient decides how his information can be used. Barnickel et al. [4] proposes a cryptography system using the user/password model to protect patient data. Every time data needs to be accessed, the users prompted for his username and password, and then a session is started. The session is automatically terminated if the application stays idle for a conjure amount of time, forcing the user to authenticate again. Along the same lines, Chen et al. [10] propose a cloud based security system for sharing patient's data among deferent institutions. When a record is accessed by an organization that does not own it, permission is requested to the owner(except in emergency cases).

3.6.1 Closing remarks on the security area

We observed that privacy and security of medical data is often mentioned in the papers analyzed. This concern is due to the fact that, if this data is intercepted by a malicious party, it may expose private and personal aspects of the patients' lives. Also, another concern goes around frauds involving medical data, such as false requests of insurance prizes. We did not get further into those issues.

3.7 Notifications

The solution presented in Du et al. [13] focuses on a system in which the user can send emergency alerts to family members and doctors. We observed that the main focus of the solution lies not on how the patient interacts with the system but on how the alerts are sent. The authors did not take in consideration whether the patient will have physical conditions to use the system or not, or if the patient

Challenges for the mHealth Area

In this section we summarize the identified challenges found during our literature review. First, as mentioned earlier, several papers highlight how battery lifetime is a main concern. Batteries currently cannot withstand a full work day (e.g. Heslopet al., 2010 among others). Secondly, multiplatform development is a concern for other authors such as Fernandes et al. (2011); iOS, Windows Phone, and Android being the most common choices. Third, delays in data transmission and their consequence on patient monitoring is another current challenge (e.g.Soomro and Schmitt, 2011).

Finally, a common factor listed among the studies of literature review is the struggle to implement the project or software architecture in real environments. For instance, (Gomes et al., 2012) presents a model for software development in the healthcare area, but the authors identify the need to validate the model in real environments. Despite health care solutions around the world demand for new technologies, the inherent diverse environments, security issues, and some-times people's resistance to change remain important issues to be addressed. the programming of sensors using what the authors call senselets. Senselets are blocks that run in between the sensors and the application, they are plat-form independent and they abstract sensor calls. In the presented prototype, the authors manage to, in some cases, obtain a reduction of over 75% on the initial source code lines required (from 72 to 17 lines in the case of a fall detector application).Mobile devices present a special issue regarding battery use. Warren et al. [38]presents a service oriented framework for monitoring applications. The frame-work is composed of three software components: 1.The device service, which runs on the smart phone and is responsible for the management of data and communication; 2.The surrogate, which runs in a server and serves as an inter-face between the mobile device and the other services and its clients; and 3.Thesurrogate-host, which acts as a surrogate container. Furthermore, the framework implements context-aware characteristics. As an example of this feature, the framework may change the current connection type for one that uses less battery (e.g. Wi-Fi to Bluetooth) when available. In the study of Constantinescu et al. [12], a framework for medical multi-media data is proposed. A daemon of the framework is attached to mHealth applications, collects the multimedia data and adapts them to be viewed using different methods (web browser, mobile devices, etc.). Also, these daemons may communicate to each other, creating a data cloud that is transparent to the user.

3.7.1 Closing Remarks on the Framework Area

The proposed frameworks focus on different aspects, nevertheless, it is easy to identify a common ending among these studies: all of them try to make the development of mHealth applications an easier task. In Ahmed et al. [2], the authors state that a big advantage of mHealth is that it is a convenient way for the user to access his medical information. It also makes the communication between patients and doctors easier.

3.8 Security

Ahmed et al. [2] proposes a framework to force security policies in mHealth applications for Android devices. This is done using a system that marks the sensitive data. The framework taints the data when it is stored and then monitors the data ows in the device. When tainted data is requested for another application or for transmission, the framework uses pre-established rules to manage these requests, granting or not access to the data. Also, the authors state that the framework can intercept the actions of malicious scripts, as it runs in a layer above the layer these scripts usually run. As an example of this functionality,

IV. CONCLUSION

In the paper we have surveyed different recently developed applications of embedded to mobile phone sensors. Some of these applications are already distributed and used for medical purposes, but the other are research projects so far. The main reason to use mobile phones in healthcare domain is to improve quality and availability of the healthcare services

Variety of mobile sensors are used in existing application It can improve quality and decrease cost of healthcare services The combination of intelligent data processing for clinical decision making processes and subsequently alert agents and healthcare professionals alike is a step towards optimization of dynamic healthcare monitoring services tailored according to each individual user.

REFERENCES

[1] Ramez Elmasri and Shamkant B. Navathe. Fundamentals of Database Systems, 4th Edition. Addison-A. Toninelli, R. Montanari, and A. Corradi, “Enabling secure service discovery in mobile healthcare enterprise networks,” IEEE Wireless Communications, vol. 16, pp. 24–32, 2009.

[2] R. Lu, X. Lin, X. Liang, and X. Shen, “Secure handshake with symptoms-matching: The essential to the success of mhealthcare social network,” in Proc. BodyNets’10, Corfu Island, Greece, 2010.

[3] Y. Ren, R. W. N. Pazzi, and A. Boukerche, “Monitoring patients via a secure and mobile healthcare system,” IEEE Wireless Communications, vol. 17, pp. 59–65, 2010.

[4] R. Lu, X. Lin, X. Liang, and X. Shen, “A secure handshake scheme with symptoms-matching for mhealthcare social network,” MONET, vol. 16, no. 6, pp. 683–694, 2011.

[5] M. R. Yuce, S. W. P. Ng, N. L. Myo, J. Y. Khan, and W. Liu, “Wireless body sensor network using medical implant band,” Journal of Medical Systems, vol. 31, no. 6, pp.
467–474, 2007.

[6] M. Avvenuti, P. Corsini, P. Masci, and A. Vecchio, “Opportunistic computing for wireless sensor networks,” in IEEE Proc. of MASS’07, pp. 1–6.

[7] A. Passarella, M. Conti, E. Borgia, and M. Kumar, “Performance evaluation of service execution opportunistic

