

Internet of Things as Intimating for Pregnant Women's Healthcare: an Impending Privacy Issues

Mir Sajjad Hussain Talpur^{*1}, Murtaza Hussain Shaikh², Riaz Ali Buriro³, Hira Sajjad Talpur⁴, Fozia Talpur⁵, Hina Shafi⁶, Munazza Ahsan Shaikh⁷

¹School of Information Science & Engineering, Central South University, Changsha, China

²Member IEEE, Oslo, Norway

^{3, 5, 6}Faculty of Agricultural Social Sciences, SAU, Pakistan

⁴Central China Agriculture University, China

⁷Liaquat University of Medical and Health Sciences, Pakistan

*Corresponding author, email: mirsajjadhussain@csu.edu.cn¹,

murtazahussainshaikh@gmail.com², abbas_buriro14@hotmail.com³, hirasajjad@gmail.com⁴,
fozia.t@gmail.com⁵, shafihina@gmail.com⁶

Abstract

Ingeniously, the innovations are taking place in current medical era, where IoT is a key and its related technology plays a dynamic role in pregnant women care taking inside hospital and outside. IoT ensure the effective and efficient care of pregnant women in any environment because intelligent tiny devices like RF-Tags, sensors are attached with pregnant women, and all the activities of pregnant women can be monitored by professional medical staff from anywhere and anytime. The usage of these advanced technologies in pregnant women care environment, absolutely eradicates the pregnancy complications and harmful incidents, but also increases privacy, religious, legal and societal problems. The purpose of this article is to discuss the usage of IoT in pregnant women healthcare environments and articulates endorsements to promote research then can guarantee that the pregnant women's privacy is preserved.

Keywords: internet of things, pregnant women healthcare, components, practitioners, privacy

Copyright © 2014 Institute of Advanced Engineering and Science. All rights reserved.

1. Introduction

Time and distance are crucial factors for pregnant women in critical situation. As we know that pregnant women's they living in remote areas and they probable cannot receive immediate treatment during the emergency; because, in the remote areas there is the shortage of primary care providers (e.g. Gynecologist, Physician, specialist and nurses etc) and the closing of small healthcare centers have been problem identified in many remote areas [30, 31]. Some research has been undertaken and few techniques have been developed to remotely monitor the physiological condition of pregnant women through the sophisticated ultrasound machine. There are various ways to reduce the pregnancy complications and maternal deaths, and an important step is to select right technologies, methods and approaches to achieving this reduction [4], [6], [7, 8], [14], [20]. One such method is the utilization and involvement of smart IoT technology in pregnant women care taking.

As the fads of pregnant women healthcare entering into civic and pregnant women health concerned are steadily perfect, people need effective pregnant women healthcare system which make sure the excellence of care and eliminate the pregnancy complications, hazardous occurrences. Consequently, considerations of a remote pregnant women healthcare system are crucial and immediate, and IoT would be the most effective for its deployment. IoT offers the lot of prospects of determining pregnant women care taking system information about tagged pregnant women. With using IoT, real world pregnant women care taking actors can be merely identifiable, traceable, and monitorable. These things might be outfitted with gadgets such as Smart RFID tags, actuators, and sensing units. Internet of things enables pregnant women, Gynecologist, medical professional, specialist, nurses and points to be connected

anytime and anywhere, with anything and anyone. In the area of remote pregnant women healthcare system enormous study work that has accomplished lot of desired outcomes, utmost particularly reflected in the numerous healthcares' smart technologies [11], [20].

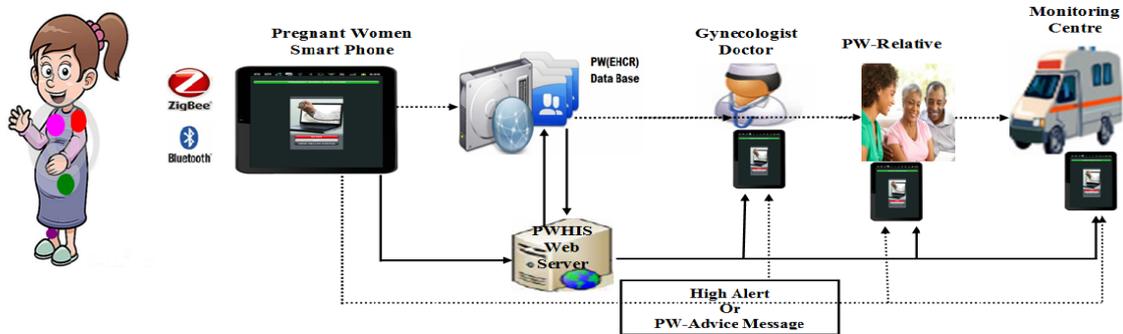


Figure 1. IoT Based Pregnant Women Healthcare System

The main actors in this system are pregnant women, gynecologist, body sensors and pregnant women electronic healthcare information databases with web server. Healthcare relevant information and events are sent via Wireless Body Sensor Network (WBSN) with Zigbee and Bluetooth to the pregnant women smartphone(Gateway), pregnant women EHCR in the distributed database through Internet; EHCRs can be accessed from anywhere and at anytime by gynecologist, pregnant women and other related healthcare actors are permitted to consult them.

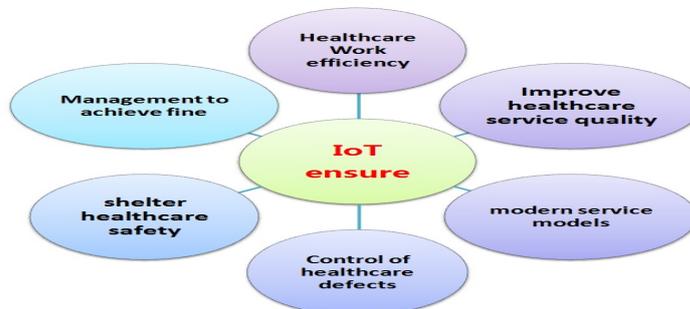


Figure 2. Potential of IoT in Pregnant Women Healthcare

Though, these cutting-edge technologies are still stay in the aviator phase, far away from the real functional usage.

This paper gives an overview; How efficacious involvement of IoT and its related technologies in pregnant women care taking environment? How could it be guaranteed that personal data of the pregnant women would certainly not collapse in the hands of aliens? Is the use of IoT complaint with HIPAA, AMA, and EUDPL? Will the use of IoT increase privacy, religious, societal & legal issues? And also expresses endorsements for advance research that could guarantee that the pregnant women’s privacy and religious, social self-respect are preserved.

2. IoT Deviations in Pregnancy Care

Internets of things technologies are making it possible for a healthcare organization to monitor the physiological condition of pregnant women prospective inside clinic and in home

anytime, anyplace from anywhere. Internet of Things has enormous in pregnant women healthcare system and medical service to improve pregnant women safety, healthcare services and also reform the future of our medicinal atmosphere, knowledge, economy and culture as a whole. However, the pregnant women privacy information problem has become a severe issue in the real pregnant women healthcare service environment [17-19], [24], [28]. IoT based applications may significantly progress clinic efficiency; they also may create privacy threats that harm pregnant women's more than they benefit them. Additional, the privacy threats linked with IoT technologies are problematic to comprehend. When pregnant women's private data is occupied, clinics must adhere to privacy principles that endorse the flow of complete information and permit patients to make rational choices when they choice to hospital IoT applications. Otherwise, IoT hospital technologies may be implemented in ways that do not serve pregnant women's long term privacy interests [21-23].

In fact, IoT dramatically change the shape of pregnant women healthcare environment and make them effective, efficient because it covers a wide range of technologies including sensing, tagging, storage, networking, and computing, which together shape realistic complex cyber physical and social systems to sustenance smart healthcare applications [12, 13]. This posture, several challenges related to pregnant women privacy, admiration for authority, self-esteem and independence [9, 10]. IoT based PWHCS (Pregnant Women Healthcare System) is a system which offers information to users so they can analyze a physiologically condition of pregnant women's inside hospital and outside and make decisions timely, system have the benefit of being able to amalgamation specific pregnant women information, do complex evaluations, and present the results to Gynecologist, Physician speedily anytime anywhere. System can contribute to improving different aspects of real time data accessing quality of pregnant women, for instance: completeness and timeliness. System can contribute to better monitoring the current status of pregnant women; they can generate reminders to ensure that planned actions are not elapsed. The complications of pregnancy stems facing in outside of hospital especially in rural areas. On the basis of recent report of the World Bank it declares that sixty percent of the young pregnant womens are belongs to remote regions [30, 31]. Substantiation suggests that rural locals have actually restricted access to healthcare and that rustic areas are underserved by healthcare physician. In the establishing and developed world, several remote citizens should get an appointment from the doctor in order to visit on time to reach hospital but sometime they get lets [30].

Women wellbeing in pregnancy period, delivery and the post-partum dated. The major causes of maternal morbidity and mortality include ovary infection, depression, high blood pressure, and obstructed labor [31]. IoT based pregnant women care taking system would greatly reduce the number of these needless deaths and also enhance the lifestyle of pregnant women and allow them to live in rural areas where there home town, because IoT devices are attached to pregnant women and all the activities can be monitored by doctors from anywhere and anytime so it gives the assurance of pregnant women safety [29]. Most of the new healthcare applications scratch the requirement for elucidations that safeguard peoples from religious and privacy hazards as a consequence of abuse and inappropriate use of these Internet of things smart applications [25-27]. The usage of IoT devices to monitor the physiological condition of pregnant women inside the hospital and outside, anytime, anyplace from anywhere this raises privacy invasive by Gynecologist, and physician. Protection of information and privacy of pregnant women's is one of the key challenges in IoT. Lack of privacy measures will result in reduced acceptance among citizens and therefore is one of the motivating factors in the success of the IoT in the field of pregnant women healthcare.

Baseding on social demands, which are illustrated in the lawful requirements, personal privacy of people' health care records is an extremely burning issue. Most of the regulations entitles the local as the owner of her clinical data and supplies her more rights compared to anybody else on her clinical records. This recommends that it is required to get consensus from pregnant women, when her clinical documents are accessed for any type of objective [15, 16]. The question is why personal privacy of clinical information is so important and crucial? Considering that, Privacy is in the attributes of humans, and it provides the human a psychological fulfillment and a sensation of self-confidence and social wellness, if they could restrict accessibility to their individual illness record according to their inclinations. People might have mental, emotional, psychological, or sex-related ailments, and they would not such as to subject those problems to others. It is claimed that A Health problem is affixed to an

Abnormality". People can stay away from opting for treatment if they are afraid that their disease, problem would certainly be subjected to others including friends, family members and coworkers. So the pregnant women privacy is the key success factor of IoT in healthcare issues, religious, ethical issues. It is fact that pregnant women essential medical information belongs to the stringent privacy territory of the pregnant women. In the 2009 released investigated report of AMA regarding the Radio frequency identification (RFID) gadgets used in medical area might save the life of patients in critical state and also make them more relax and comfortable [1-3], [25], [28]. The American medical association endorses that during the permission process for RFID implantation, clients ought to be informed of clinical suspicions associated with these gadgets. Though, health plan makers and physicians should comprehend that RFID tools, unlike various other kinds of medical modern technology, must an effect after patient's personal privacy that expands far past the clinical sector. Through an inserted RFID gadget, patients could be tracked by anyone making use of a common RFID reader. "The permission procedure needs to offer this danger plainly, and the AMA needs to modify its report to specifically address this uncommon risk" [12], [18, 19]. The United states FDA (Food and Drug Administration) authorized in 2004 the initial passive RFID tags particularly planned for human implantation. Human implanted passive RFID tools that recognize patients can additionally have important wellness details [4], [23] The tags are mostly visualized for patients with major conditions, such as brain hemorrhage condition, persistent obstructive lung illness, diabetic issues, stroke problem are implanted into clients with clinical tools such as endoscopy capsule, stents. These gadgets having smaller size such grain of rice, and could be easily injected in skin or implanted in body of the patients. The injected and implanted RFID gadgets offer an effective access to critical informations for people yet this crucial clinical detail goes also to the stringent privacy sphere of the patient.

3. Analysis of Privacy Concerns

It is fact that Internet of things and other advanced technologies have huge potential in pregnant women healthcare system and medical service to advance pregnant women safety inside the clinic and outside, healthcare services and also reforms the future of our medical atmosphere. Furthermore, the speedup privacy & ethical issues of pregnant women which we analyze in this section;



Figure 3. Pregnant Women Healthcare and PrivacyConcern

In such a smart system, where a pregnant women is completely eased with IoT technology, numerous hazard factors also ascend to her health information and health concerns, which are the component of pregnant women healthcare system.

3.1. Pregnant Women Caring Inside Clinics & Information Privacy Protection

The majority of the healthcare providers/organizations, merely concentrate on people passion regarding the modern technologies which were used in healthcare facilities for keeping track of the physiologically state of pregnant women's which were accepted in healthcare facility the pregnant women provides accord to the use of such applications. On the basis of authors analysis and present literature reveals that healthcare facilities does rule out a few of the standard rights of the people, the HIPAA precisely suggests that patients' personal privacy would be stressed, and this idea could be completely realistic to the whole wellness sector market in all over the world. In the EU medical data protection regulation of 1995 [15], [25, 26] the hospital must not gather medical data of the client that it is not require for the medical solution nor save the gathered info anymore after that stringently required for the facility it offers. Pregnant women healthcare inside the medical facility, the primary target is to monitor, gather and keep pregnant women's wellness information from different kinds of wearable gadgets, which are situated on the pregnant women, while in addition forward that information in to general-purpose computing devices- for a lot more advanced and complex processing. In the pregnant women health and wellness surveillance system, it would be guaranteed that the right Client is being detected, that information is forwarded out to the accurate health information systems, which first certified persons have accessibility to the sensing unit information, so the identity confirmation for people, Gynecologist, doctor and Healthcare facility health information database or data source is basis personal privacy need.

3.2. Pregnant Women Caring Outside Clinics & Information Privacy Protection

With the Rapid advancement of IoT, in-residence pregnant women healthcare monitoring is inexpensive and possible. Different kinds of very small sensors and RF-tags can be used at residence to keep track/monitor physiological parameters of pregnant women. Wearable gadgets, such as wrist-worn, bracelet, chest belt, vest belt, heart belt, and textile, woven and electronic sensors, seamlessly integrated in textiles through consumer electronics, embedded in stylish smart clothes(shirts, jackets etc.), and automated wristwatches to belt-worn personal digital assistants with a smart display unit. Through wearable devices healthcare providers/ medical professionals can effectively monitor the physiological parameters of pregnant women inside the home and outside and also save the life of pregnant women in emergency situation. Pregnancy stems experiencing in beyond medical facility particularly in rural areas from present Globe Bank stated that 60% of the adolescent pregnant women are from wilderness [23]. Proofs indicates that remote areas peoples have limited access to healthcare [16] and that wilderness are under served by healthcare physician [14]. In the establishing and developed globe, numerous rural locals need to travel times to get to care compared to their city equivalents [2]. The major reasons for maternal illness and death consist of ovary infection, unhappiness, high blood pressure, and obstructed labor [2]. Every day, 1500 women pass away due to problems in pregnancy, 10 thousands children daily pass away within the initial month of life and an approximately equivalent variety of infants are born dead [2] IoT based pregnant women care taking system would considerably lessen the number of these unnecessary deaths as well as augment the way of life of pregnant women and permit them to stay in rural areas where there residence town, since IoT devices are affixed to pregnant women and all the tasks can be kept an eye on by doctors from anywhere and anytime so it provides the assurance of pregnant women protection. These novel applications scratch the necessity for remedies that shield people from moral and privacy hazards as a consequence of abuse and misappropriation of these Internet of things applications. The problem will certainly be a lot more popular in future applications that make sure pregnant women health care outside healthcare facilities. IoT smart applications support the pregnant women to remain lengthier in her local atmosphere. These applications certainly mark this feasible in keeping an eye on the physical health condition of the pregnant women in her house, protect the life of pregnant women in pregnancy complications (e.g. pulse rate, blood pressure, body temperature, glucose/sugar level and hemoglobin). However also when the pregnant women provides authorization that a health professional and family-related & friend have accessibility of designed system it can likewise be thought about extremely personal privacy intrusive, feasibly captivating away the privacy as well as self-confidence of the pregnant women. No-doubt pregnant women certainly are capable to change the entire system.

3.3. Is IoT Applications are Privacy Friendly?

Internet of things will certainly have a lot of applications in the medical domain, with the prospect of smartphone through Radio frequency identification tiny-sensor abilities as a platform for monitoring the pregnant women health vital signs and medication distribution. The benefit acquired in deterrence and reliable observing of ailments, verdict and offer speedy health measures in the serious pregnancy complications. Wearable, Ambient tiny sensors and smart gadgets could be deployed to store pregnant women medical informations that could protect a pregnant women's life in serious conditions. From the foregoing study it could be determined that the IoT generates a great deal of prospects to rise the efficiency of pregnant women healthcare taking inside the hospital and outside, to rise the suitability for the pregnant women, to provide her the prospect to stay lengthier at residence, to decrease the period consumed in clinics for treatment surveillance, to rise the pregnancy diagnostic efficiency, enhance the healthcare services available for caretakers, to give the effective treatment to pregnant women at a minimum cost. Currently, in literature, privacy, religious, social, legal and ethical risks are vital challenges in IoT based pregnant women healthcare system. Absence of privacy measures will outcome in diminished acceptance among citizens and consequently one of the motivating reasons in the success of the IoT.

An impetuous instance that clarifies what could occur is the healthcare of pregnant women. Every Gynecologist, physician illuminates that defensive checkup and timely care are important to proliferation the strength level for pregnant women. Numerous researchs exemplify pregnancy complications proportions that are greater for some humanities such as Muslim women's. The key cause for late treatment and illuminates the lesser chance for persistence. With the usage of IoT technology in pregnant women healthcare taking system this discovery is too significant. If these IoT based smart healthcare applications do not shelter privacy anxieties of the pregnant women's the hazard occur that certain citizens fretful with their privacy and self-respect will not practice the prospects of progressive in-residence pregnant women care taking. The assumption is that pregnant women health information privacy and medical information fortification structures are serious for some applications. In what way this can be guaranteed is a question of a widespread civic discussion of the previous years [18].

3.4. Regulation

Regulation having some own values and is an efficient ways to secure the personal privacy and moral privileges of the pregnant womens. The EU has a series of Instructions, of which the individual information is the crucial essential to shield the privileges of its residents [24] this lawful agenda is a tool to instruct what the vital information fortification and safety constraints are of such applications and delivers to eliminate prohibited conduct that should certainly endanger the privacy of residents and clients.

3.5. Privacy Aspects

Personal privacy and protection need to be entrenched in healthcare applications to reduce the threat for the clients. Study for personal privacy improving solutions is required for applications. The healthcare market has actually acknowledged this vital and ongoing investment in technologies such as Encryption, Role-based access control, Digital Signatures, Authentication Mechanisms, Regulations on patients' privacy at home, Data mining rules and technological measures which ensure the personal information privacy protection of patients; adversary cannot drip the personal information of clients. The European Commission, AMA and HIPPA invite such creativities and launched lately an interaction on the significance of privacy improving technologies [23-26].

3.6. Social Sculpting

Astoundingly sufficient, within the various publications in the field, very little can be located on the significance to spend in healthcare information management system modern technologies to assure personal privacy and pride of clients. In residence treatment application situations it is unblemished that concierges should have accessibility of more medical knowledge to support pregnant woman when required. Even when the pregnant woman has actually given approval this in some cases could be unpleasant. To evade these problems IoT applications for residence treatment need to have the ability to carry out pregnant women healthcare monitoring and to determine, making use of reliable intellect methods, if a pergenant

women conduct might be fit as weird and perhaps imperiling her health prompting the demand for relief from healthcare professionals. Additionally the point that considerably fewer information is communal with caretakers it creates the application additionally far much effective: Caretakers obtain a request just when reasons already existing to be troubled regarding the pregnant women.

4. Conclusion

The inspiring ravages of this system provide a strong rationale for a durable, medical trial to determine whether this pregnant women healthcare system improves pregnant women healthcare control in the community among pregnant women with uncontrolled health complication. The paper exemplified in what way IoT is utilized nowadays in experimental applications in clinics and envisages IoT application settings for pregnant women care in the future. On the basis of existing literature it determines that several these application settings are sturdily privacy intrusive. Our investigation determines that further more investment in privacy improving technologies is required to guarantee approval of the applications by the patients. It also recognizes, and this is the utmost significant conclusion, IoT based health monitoring information study as vital means to guarantee that the privacy and self-respect of pregnant women's, especially in outdoor healthcare is esteemed.

Acknowledgements

This work is supported by the National Natural Science Foundation of Peoples Republic of China under grant numbers 61073037 and 61103035, and the Ministry of Education Fund for Doctoral Disciplines in Higher Education System, under grant number 20110162110043 / 2012-2013.

References

- [1] Chunxia Leng, Huiqun Yu, Jingming Wang, Jianhua Huang. Securing Personal Health Records in Clouds by Enforcing Sticky Policies. *TELKOMNIKA Indonesian Journal of Electrical Engineering*. 2013; 11(4): 2200-2208.
- [2] Haiwen Han, Weiping Zheng. A Privacy Data-oriented Hierarchical MapReduce Programming Model. *TELKOMNIKA Indonesian Journal of Electrical Engineering*. 2013; 11(8): 4587-4593.
- [3] Ruijuan Zheng, Mingchuan Zhang, Qingtao Wu, Chunlei Yang, Wangyang Wei, Dan Zhang, Zhengchao Ma. An IOT Security Risk Autonomic Assessment Algorithm. *TELKOMNIKA Indonesian Journal of Electrical Engineering*. 2013; 11(2): 819-826.
- [4] Zhang, Yuhai, Yongyong Xu, Lei Shang, and Keqin Rao. An investigation into health informatics and related standards in China. *International journal of medical informatics*. 2007; 76(8): 614-620.
- [5] Aiken Linda H, Sean P Clarke, Douglas M Sloane. Hospital staffing, organization, and quality of care: cross-national findings. *International Journal for Quality in Health Care*. 2002; 14(1): 5-14.
- [6] Cortés, Ulises, Cristina Urdiales, Roberta Annicchiarico. Intelligent healthcare managing: an assistive technology approach. *Computational and Ambient Intelligence. Springer Berlin Heidelberg*. 2007; 1045-1051.
- [7] Sillence, Elizabeth, Pam Briggs, Peter Richard Harris, and Lesley Fishwick. How do patients evaluate and make use of online health information?. *Social science & medicine*. 2007; 64(9): 1853-1862.
- [8] Alsinet, Teresa, Carlos Ansótegui, Ramón Béjar, Cèsar Fernández, and Felip Manyà. Automated monitoring of medical protocols: a secure and distributed architecture. *Artificial Intelligence in Medicine*. 2003; 27(3): 367-392.
- [9] DATA, MOVEMENT OF SUCH. Directive 95/46/EC of the European Parliament and of the Council of 24 October 1995 on the protection of individuals with regard to the processing of personal data and on the free movement of such data. *Official Journal L 281*. 1995; 23/11: 0031-0050.
- [10] Dixon, Pam. Medical identity theft: The information crime that can kill you. *The world privacy forum*. 2006.
- [11] Marconi, Jennifer. E-health: navigating the Internet for health information healthcare. *Advocacy White Paper*. 2002; 1-6.
- [12] McLean, Athena. Ethical frontiers of ICT and older users: cultural, pragmatic and ethical issues. *Ethics and information technology*. 2011; 13(4): 313-326.
- [13] Hoof J van, HSM de Kort, Panos Markopoulos, M Soede. Ambient intelligence, ethics and privacy. *Gerontechnology*. 2007; 6(3): 155-163.

- [14] Mun K, SK Mun. RFID in Healthcare: The Applications, and Obstacles, Are Many. *Journal of AHIMA*. 2006; 77(8): 56-62.
- [15] Yang, Che-Ming, Heng-Ching Lin, Polun Chang, Wen-Shan Jian. Taiwan's perspective on electronic medical records' security and privacy protection: Lessons learned from HIPAA. *Computer methods and programs in biomedicine*. 2006; 82(3): 277-282.
- [16] Barrett, Rob, Paul P Maglio. *Informative Things: How to attach information to the real world*. Proceedings of the 11th annual ACM symposium on User interface software and technology. ACM. 1998; 81-88
- [17] Jara Antonio J, Miguel A Zamora, Antonio F Gómez-Skarmeta. *NFC/RFID applications in medicine: security challenges and solutions*. Intelligent Environments (Workshops). 2009; 117-124.
- [18] Jara Antonio J, Miguel A Zamora, Antonio FG Skarmeta. *Secure use of NFC in medical environments*. RFID Systems and Technologies (RFID SysTech). 5th European Workshop on. VDE. 2009; 1-8.
- [19] Robson S, G Gyory. OpTag-a combined panoramic photogrammetric and radio frequency tagging system for monitoring passenger movements in airports. *International Archives of Photogrammetry, Remote Sensing and Spatial Information Sciences*. http://www.isprs.org/commission5/proceedings06/paper/1262_Dresden06.pdf [Accessed 29th November 2006].
- [20] Vermesan, Ovidiu, et al. *Internet of things strategic research roadmap*. O Vermesan, P Friess, P Guillemin, S Gusmeroli, H Sundmaeker, A Bassi, et al. Internet of Things: Global Technological and Societal Trends. 2011: 9-52.
- [21] Janise Richards, Gerry Douglas, Hamish SF. Fraser MBChB, MRCP, Perspectives on Global Public Health Informatics, Public Health Informatics and Information Systems Health Informatics. *Springer London*. 2014; 619-644.
- [22] Stevens, Gina Marie. *A brief summary of the medical privacy rule*. Congressional Research Service, Library of Congress. 2003.
- [23] Sotto, Lisa J. Testimony on Privacy Issues Associated with the use of RFID Technology in Health Care Setting. 2008.
- [24] Mault, James R. *System and method for remote pregnancy monitoring*. U.S. Patent No. 6,610,012. 2003.
- [25] Kulynych, Jennifer, David Korn. *The New HIPAA (Health Insurance Portability and Accountability Act of 1996) Medical Privacy Rule Help or Hindrance for Clinical Research*. *Circulation*. 2003; 108(8): 912-914.
- [26] Gilbert, Françoise. *Privacy of Medical Records-The Health Insurance Portability and Accountability Act of 1996 Creates a Framework for the Establishment of Security Standards and the Protection of Individually Identifiable Health Information*. *NDL Rev*. 1997; 73: 93.
- [27] Atkinson, Robert, Daniel Castro. *Digital quality of life: Understanding the personal and social benefits of the information technology revolution*. Available at SSRN 1278185. 2008.
- [28] Vilamovska AM, E Hattziandreu, R Schindler, C Van Oranje, H De Vries, J Krapelse. *RFID Application in Healthcare—Scoping and Identifying Areas for RFID Deployment in Healthcare Delivery*. RAND Europe. 2009.
- [29] Jones, D. *Smart cards-The key to secure and flexible health care provision*. *Card Technol*. 2003; 15(8).
- [30] Firoz, Tabassum, Doris Chou, Peter von Dadelszen, Priya Agrawal, Rachel Vanderkruik, Ozge Tunçalp, Laura A Magee, Nynke van Den Broek, Lale Say. *Measuring maternal health: focus on maternal morbidity*. *Bulletin of the World Health Organization*. 2013; 91(10): 794-796.
- [31] World Health Organization. *Women and health: today's evidence tomorrow's agenda*, WHO report, WHO Press. 2009; xviii: 91.