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Novel Healthcare Solution for Smart Hospitals: A Qualitative Review

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Abstract
We described an innovative solution for treatment and healthcare of a patient in hospitals and clinics by collecting some information from previous research where the patient needs a quick response on the basis of precise, accurate and reliable results. We are talking about a system for 24/7 monitoring of patient's health and vital signs and also can keep a record of all the data with less human efforts. Using wearable biosensor devices and ICT (Information and Communication Technology) in combination with algorithms for an intelligent system to sense, analyze, display, record and alarm/alert in real time. We have described the system and its applications for smart hospitals to work more efficiently, fast, more reliable with precision, accuracy and time saving more remarkable increase the ratio for lifesaving and life expectancy rather than other conventional methods adopted for healthcare used in hospitals.
Keywords: Healthcare, hospitals, clinics, biosensors, ICT.

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Introduction

Healthcare with Smart, efficient and quick response is always a challenge worldwide that's why development in the methods of traditional medicine and healthcare systems/technology is most widely emerging part for researchers as well as for industries 00. Using precise technologies increases not only solution for healthcare but also survival rate, safety, and life expectancy 0.

Hospitals need to leverage information and communications technology (ICT) to improve their operational and management efficiency and lower their operating costs to ensure people's health while contributing to sustainable social development 0. As the demand for healthcare system increasing worldwide because modern medicine is changing to the digital data science, current methods for handling huge data cannot meet the requirements, it will raise the probability of risk, unsatisfactory results, and services 0. Finally, to escape from this rising amount of problem and conflicts intelligent approaches are required 0, 0 to give the people the best healthcare solutions more efficiently, quickly and without any misleading results.

Particularly, the combination of biomedical equipment and IT infrastructure is playing an important role to

make this dream come true for smart hospitals 0. Especially, the dominance of smartphones, powerful, ubiquitous smart sensors, wireless technology, software's and data storage can make possible the infrastructure for a state of the art smart hospital 0.

It is required to create an IT framework and smart devices that are extremely limber so that heedless of what is coming along in the next few decades the IT solution is already there and we can easily consume the new technology 0. As we can see the advancement is coming day by day in the biomedical engineering and clinical processes like biomedical equipment with high precision sensors for heart rate, body temperature, humidity, bio transducers, electrochemical biosensors, piezoelectric sensors and Quartz crystal microbalance as a biosensor and a lot of more. Hospitals should be smart because conventional and efficient processes cause major waste of time in staff daily activities. A hospital must be considered by definition a streamlined organization; whatever happens, must be alert, and

should trigger the related procedure. Time is never to be wasted, proper workflow management should be in place for system-to-system, system-to-human and human-to-human communications 0.

The novel feature of smart hospitals

The smart hospital will have a fully automatic and integrated electronic medical data (base) record system. As the data from the biosensors system will be accessible to be displayed on Smartphone and IPad. It will also be recorded for future reference in parallel on a storage server, so rather having a number of various clinical systems, there will be only one huge incorporated platform. Just like having a big highway with much extra line we might have no need for it now, but as we grow later so we are ready to adopt that extra line without any system updating or any changes in the infrastructure 0.

This evolution is involving human into system mechanism 0 because human and computer are excellent combinations as both have different intelligence but when both are combined they are more powerful, then we can imagine. It means to combine two main intelligent system of the world together 0, 0.

Current advancement in technology of network & sensors, integrated circuits with less power requirement, and high data wireless communication systems have to make a path to design the low-cost and low-power, abstract, less weighted, and intelligent physiological and medical sensor modules 0. This evolution of technology enables us to imagine the system that can make the world a better place, so this is why quick response and reliable results for patients in hospitals and clinics are becoming more and more important 0.

These advancements are making huge expectations and contribution to the future smart world, where people will be able to monitor their health, to some extent which will make a person healthcare administrative and keep himself away from hospitals and doctors. It would bring an economic relief and reduce stress working hours in hospital as well as clinics. There is obvious inflection change from measuring our health by the physical entity to sensors that attenuate in the background and track essential measurement 0. Most of the people are now interested to personally know about their health and are their healthcare supervisors. This proposal could be explaining by term called “Quantified Self” where one can personally manage their health track such as sleeping patterns, blood pressure, calories, and body fats etc 0. This paper will provide a short and brief introduction and review of smart healthcare solution in hospitals, discusses the future of healthcare and solution for quick response to the consumer (patients).

Principle of Operation for Smart Hospitals

Hospitals and other healthcare facilities require huge demand for intelligent solutions, so that they can meet the requirement of the 92%+ of doctors with handheld devices to connect to the large number of medical devices that increasingly are connected over Wi-Fi to render real time observance, accurate measurement, locating, and support patient-centered change of state **Error! Reference source not found.**. "Smart Hospital" solutions effectively lower operating costs for hospitals, reduce medical accidents, facilitate managers' doctor’s/nurses, supervisory efforts, improve response for the patients and service experience. A major part of this innovative system will consist of a wearable device for patients, a combination of hardware, biomedical sensors, and software, this device will be connected to a centralized data server through Wi-Fi (WLAN) to make them able to communicate with Smartphone’s, Tablets and personal computers using the same network 0. So if a patient’s vital sign changes it will be recorded by the biosensors, process optimize and analyze by pre-define software, then the same data will be sent simultaneously to the wireless network from the device on the patient body to data server for future reference and record keeping, also a forewarn will be send straight to the patient’s nurse and doctors on their smartphones or tablet using the same network. Eventually which result in reducing time spent on diagnoses, watching monitors and paper reports. So, the staff nurse and doctors can easily handle the situation of the subject as they have the result of the patient condition from the smart device patched to the subject body 0.

Keeping these future needs and requirement in mind, we came up with this idea to review the literature and research studies. In fact, it is very easy and straightforward to implement in the current infrastructure, Because the Smartphone, tablets, and wireless technology have played a very vital role in evolving daily life activities, and yet we can get huge advantage in medical/clinical sciences to save time, improve the healthcare system and increase longevity with quick response and reliable results. Pervasive computing provides huge opportunities for creating smart health services as essential part of future

healthcare concepts 0. it is the need for our today's and future.

The biosensor is a new interfacing technology which seamlessly is incorporated in such environment which offers various forms of customized and situation adapted medical support, containing assistance and guidance to carry out daily activities, nursing consumer health conditions, improving patient health, providing access to medical emergency and also social access. It would be like giving a vast choice of different applications and services, smart healthcare system has the potential of bringing medical, social and economic benefits to various interested parties 0. The purpose is to enhance comfort, supporting independence improving emergency response, including disease discovery, hindrance, and forecast eventually increasing the lifesaving and life expectancy.

Application Scenario

Hospitals are patient-centric during their IT-based development process, which requires that the information resource sharing platforms of hospitals be based on EMR. Hospitals need to efficiently apply information resources to clinical treatment and operational management by conducting medical and management services surrounding EMR 0.

Requirement analysis for smart hospitals

1. Establish an enterprise master patient index (EMPI).
2. Connect all information systems of a hospital.
3. Create complete EMR for every patient.
4. Reuse information resources of hospitals.
5. Build an essential public health service platform.
6. Ensure interconnection with external systems.

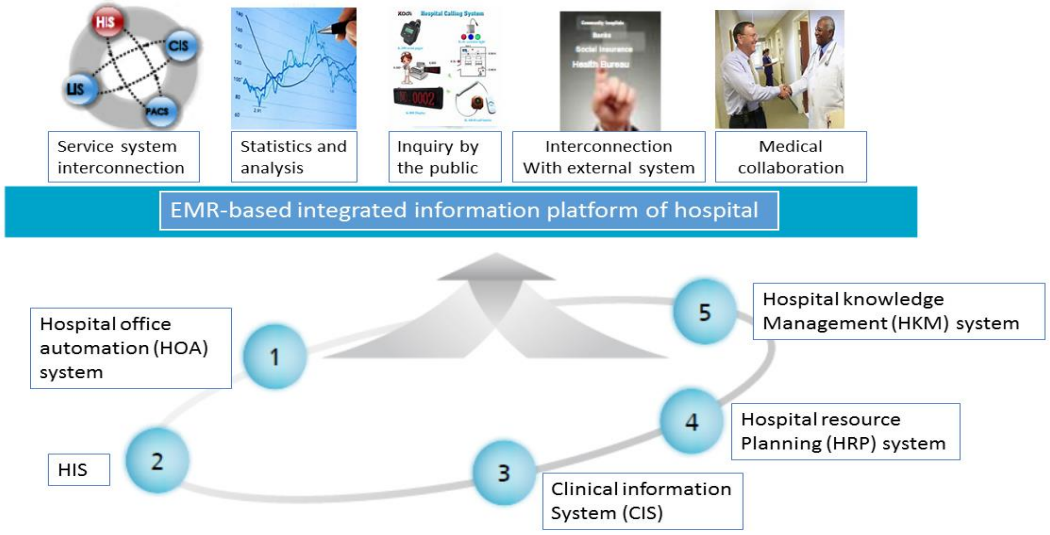

Figure 1: Overview of the EMR-based Integrated Information Platform Solution

Figure 1 Illustrates the application scenario of the EMR based smart system which is an integrated platform for information system and storage. We have to build an integrated information platform which collects, stores, and collectively manages EMR information, and is connected with the clinical information system and the management information system. With this platform, hospitals can share information resources internally and remain connected with external systems throughout the clinical treatment process**Error! Reference source not found.**, 0. This can cover all of the following needs according to the situation:

Focuses on patients and consolidates information resources.

Provides effective support for doctors to make clinical decisions based on results collected by the device patched at the patient's body. Helps hospitals administrative management departments make decisions on operational management. Achieves efficient regional medical collaboration based on information exchanges and sharing.

As the wireless local area network (WLAN) technologies are increasingly mature and hospitals are on their way to IT-based development, use of WLAN has become a trend for hospitals. Medical data needs to be strictly protected, and patient data cannot be stolen. The wireless network system may interfere with medical devices and have radiation that affects people's health. A stable network system is a basic guarantee for normal service operations of hospitals. The network must have a very low latency 0.

Smart network and communication systems for smart hospitals

The Huawei remote smart Solution enables wireless access from personal computers (PCs), personal digital assistants (PDAs), handheld devices, wireless healthcare trackers, and many other devices with the wireless network to support hospital staff's activities, such as wireless ward routine visits, asset management, personnel tracking, and online access to information. Having these wireless networks in the hospitals, we can provide available medical and emergency services for patients, thus developing the work efficiency of hospitals staff 0.

Most of the available systems for detection and prevention of medical assistance rely on falls and symptoms of heart issues and failure as their main application. Specifically fall detection becoming more important as recent statistics show that more than 30% of the people aged 65 years or more fall once a year, the same goes for 50% of the people aged over 80 years falls once a year 0. More or less one-fourth of these cases, subject suffer serious trauma with prolonging influence on their good power and independence 0. Many cases of these falls appear when subject is unaccompanied, many projects and proposal started to create remote emergency instruments, which could incapacitate people to call for help in a situation of urgency 0.

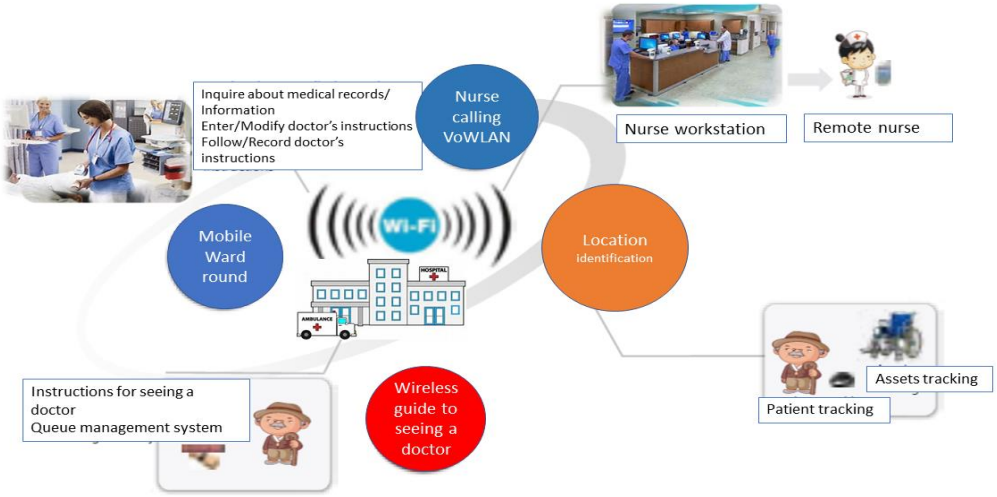

Figure 2: Application scenarios of the Mobile Smart Hospitals Healthcare Solution.

Figure 2 describes the working phenomena of the smart hospital with the remote access to the data base and sensors patched with the patient. For such situation, remote (mobile) solution are a promising choice, confirmed ground information present that patients using those devices with them are simply easy and convenient to find out about their daily health and keep the record and provide them services if there is any negative change in their vital signs. Consequently, numerous research projects established prototypes of highly precise, sensitive devices and elements being worn by the patient allowing the detection of any problem with without using any additional technology 0.

Now a day's treatment and medical science involve more data and information rather than biological information and treatment for the patients in the hospitals 0-0. The proposed solution of the self-assisted healthcare system is example psychological feature of computing project that must bring a natural phenomenon between doctors/clinicians &

biomedical data and could play a vital role in the evolution of a smart healthcare solution and would improve patient health safety 0.

Vision for future

Smart life bed

The smart system would comprise of two parts, bed coverlet, and a monitor. The Life Bed coverlet monitors the patient heartbeat, respiration, and movement. The mattress cover with an integrated sensors array, comprising of pressure switches 0. Display monitor shows this information, and also send it to the central systems in the hospital. Fig. 2 shows diagram of health monitoring system the mattress senses the vibration changes in the patient, the heartbeat, and breathing rate. It can identify the larger movements if the patient is moving or turning around. For example, if the patient is getting close to the edge of the bed, and the weight distribution does not show that they are sitting, then the network is enquired. If the fall bars are not recorded present on that particular bed, an alarm is triggered. The life bed system alerts nurses of check the patient condition using hospital's existing nurse call and paging systems [38].

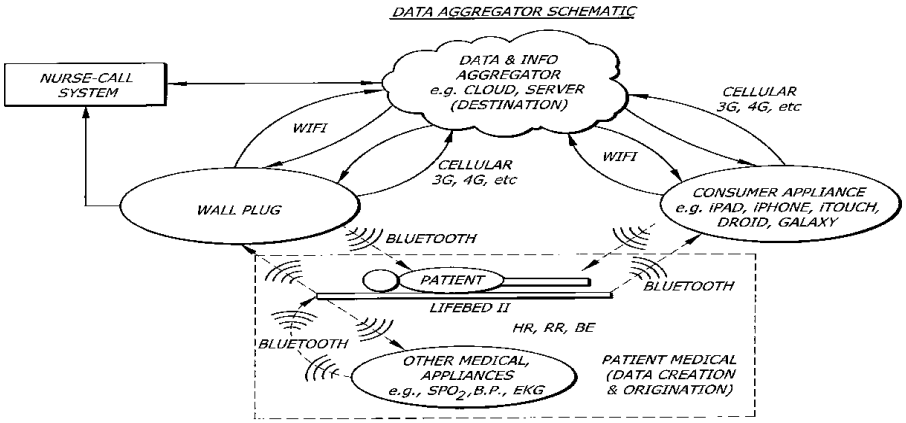

Figure 3. Network map for data aggregation in the smart hospital environment

Figure 3 illustrates the communication and data flow chart of the smart hospital call and alarming system. The alarm is triggered if breathing halts or heartbeat become too low or too fast. Data is repeatedly sent to life bed display monitor. To send the alert, a wireless call system is incorporated in the network of life beds, and it is used to page or call the designated nurses in the hospital to an imminent problem. Fundamentally, it performs a high level of intensive care for biometric signs for each patient in the hospital, without the requirement of employing more staff. Regularly it allows interference before a fall occurs, or medical staff to be notified within seconds of a problem situated. An added benefit is a different take on the ability to detect when a patient is sitting up on the edge of the bed. While they have been suggested to get bed rest, hospital staff can be notified by that bed; the very

Incorporated heterojunction smart network and calling system

There are many other ways and solution to reach the goal of smart healthcare solutions i.e. we have an application of sophisticated technology of "Watson Content Analytics." Technologically, "Watson" consists of diversified algorithms, developed in the linguistic unit of innovative computer research to present the capability of the Deep QA technologies 0. The converse is, that Watson can sense, so it needs accurate user interfaces, to update Watson current algorithms, precise as they are very far from being usable for the unexperienced user 0. Once Mark Weiser (1991) explains his vision about fading computing by his well-known sentence "the most profound technologies are those that disappear 0. We have changed this and develop it further more "The best technologies are those who are in the direct workflow," and practically not sensed as such 0.

Studies of smart healthcare solutions and smart hospital are uncommon up to now, a search in the Web of Science as of December, 30, 2014 were having only 22 hits "smart hospital" Most

outstanding example projects on activity recognition for the hospitals, carried out by group around Jesus Favela 0 they formulated a solution for automatic computation of hospital staff activities, where they discipline a Hidden Markov Model (HMM) draw the context information to the users. The knowledge of authors is known as iHospital which have an extremely synergistic smart environment concentrated on heterogeneous computing devices as shown in **Figure 4** 0.

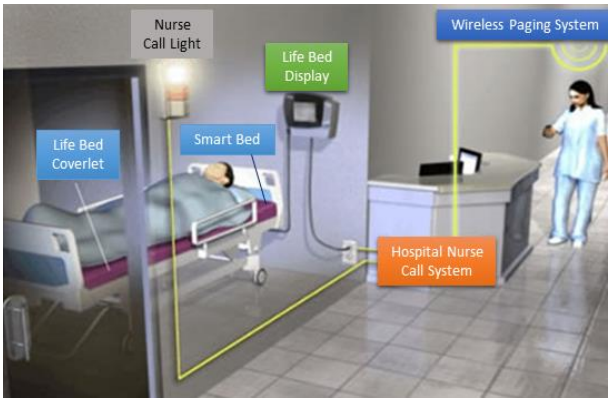

Figure 4: Illustration of smart hospital nurse call system

Information and storage for smart hospitals

Information technology performs a significant role in the development of the smart healthcare solutions in a way that any context that can be used to evaluate the condition of the subjects (patients, objects, places), considering to be related to the connection between a consumer and a present computer program 0. A literary study provides an excellent overview of the information about artificial intelligence and if that information is redefined repeated and ubiquitously, then how it is possible for users to make a precise model of data that is constantly evolving in this digital world? Incase negotiation with the system is adapted, so how do the users should avoid delays in human activities? Similarly, computing knowledge by accenting the features of entropy is the concept of stochastic processes and computation 0. It was introduced in 1960 as an economical substitute to predictable computing. It is incomparable in the way that it characterizes and processes context the order of digitized probability and utilize less complex arithmetic units; it was a primary design used in the past – because it has small and limited computation capabilities and wrong results 0. While, the Bayesian computational techniques such as Markov chain Monte Carlo (MCMC), Sequential Monte Carlo (SMC), and Approximate Bayesian Computation (ABC) techniques were matured and had to change the exercise of Bayesian statistics, nevertheless novel possibilities have been introduced with development of monolithic, multidimensional and composite dataset 0. Stochastic computation is a solution for the creation of robust and low power systems-on-chip (SOC) in nanoscale process technology which will be versatile for smart healthcare solution to enhance hospitals environment as well as services to patients and consumer0, 0.

Conclusion

Clinics and Hospitals are the foundation and groundwork for better healthcare services, and they must require to systematically deliver the finest and high-quality services solution with precise, accurate and reliable outcomes at the most economical cost ever possible. Each day there are more and more demand for quick and precise healthcare solutions that can be met in a time with effective results. As hospitals are in a strict environment to deliver services to patients in less time. The basic challenge is that most progressive and innovative technologies for healthcare reside in heterogeneous systems. Hospitals are required to espouse latest technologies and make developmental strategies to ensure safe and secure access to analyze patient condition efficiently and precisely share information with Professionals and caregivers/ nurse. Allowing greater outcomes in both economic and medical processes by reducing time to action and lowering the cost as well as human efforts. Smart healthcare is a solution for hospitals with extensive and distributive IT infrastructure that ensure the clinical & administrative workflow and communications in the most reliable and well corporate manner. A smart healthcare center is outfitted with highly sophisticated technologies like smart & intelligent communication systems, critical and emergency medical devices, sensor modules, hospital control and management system, communication and data storage tools, etc. Which helps in enhancing doctors and medical professional's productivity, clinics, and hospital services, ensure good quality of results, customer safety, and overall patient's experience. Smart hospital makes development in quality of service for patient healthcare and enhancing workflow and efficiency of the doctors and hospital staff. A system with automated and intelligent technologies can be deployed to enhance the quality of outcomes i.e. availability, safety & reliability,

efficiencies and more importantly impact on the life expectancy.

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