BUILDING SMART SAUDI HOSPITALS USING RFID TECHNOLOGIES

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Abstract: With the more advancement in impeded computing, RFID technology are gradually begun to be a necessity for improvement of medical service quality and patient safety. Nowadays,   RFID helps optimizing business processes in healthcare, improve the patients' care, reduce operating costs, helps avoiding severe clinical errors and reduce costly thefts or loss of facility equipments. For this , healthcare is predicted to be one the major growth areas for RFID. However, a real challenge still exits. That is, how to incorporate RFID successfully into medical practice, especially when relevant experience is limited. To investigate this issue, this paper surveys how RFID emerging technology is currently used to build smart Saudi hospitals. It describes in detail some of its interesting applications and its promising perspectives in several leading Saudi health care facilities. The study is expected to have several important implications for developing RFID applications in Saudi healthcare organizations.

1   INTRODUCTION

RFID is Short for radio frequency identification device, and is used to describe various technologies that use radio waves to automatically identify people or objects. (Wang et al., 2006) (Juels, 2006). An RFID system consists of an antenna and a transceiver or RF tag which contains the RF circuitry and information to be transmitted. The radio waves reflected back from the RFID tag are converted into digital information that can then be passed on to computers that can analyze the data. RFID tags can be passive tags with their data permanently burned into the tag, or can be active tags which are much more sophisticated and have on-board battery for power to transmit their data signal over a greater distance.

As RFID systems can be used just about anywhere, and because RFID are constructed from simple components, RFID is an ideal choice for hospital healthcare system. Nowadays, it is widely used in hospitals to provide real-time tracking of the location of patients, doctors and nurses in the hospital (Glover et al., 2006). In addition, the system can be used to track the whereabouts of expensive and critical equipment, and even to control access to

drugs, pediatrics, and other areas of the hospital that are considered "restricted access" areas. RFID may also be used in hospital stores to offer real-time inventory tracking that allows hospital management to monitor and control inventory supply at all times. Particularly important will be item level tagging of drugs and to reduce incidents such as surgical sponges being "forgotten" inside the patient, or to protect babies from kidnapping.

Due to its several advantages , many healthcare organizations have deployed various RFID solutions to enhance patient safety, increase operational efficiency and optimize business workflow processes.(Garfinkel and Rosenberg, 2006) (Hersh, 2004). At the same time the market for RFID tags and systems in healthcare is predicted to skyrocket from a hundred and twenty million in 2008 to about two billion in 2018, according to IDTechEXa market research firm focusing on RFID technology. (marketresearch.com/) RFID is said by many in the health industry to be the frontrunner technology for automatic identification and data collection. Considered optimal transportation and identification tools, they have become a symbol for modern hospitals. However, until there are more proven examples of its applications within the health industry and only after the benefits of RFID pay for

its relatively high implementation cost, RFID systems may not reach their full potential. To explore this issue, a project study is currently conducted to investigate the integration of RFID into the medical and health facilities at Saudi hospitals. Our project aims toward investigating how RFID can be deployed to meet the needs and practice of medical services in Saudi hospitals. It also aims toward investigation of some open problems to be solved, and the barriers it has to overcome to be fully integrated in eHealth applications in the Saudi healthcare community.

For our case study, the following methodologies are used:

- Data collection from various sources such as official records, Saudi health organization proposals and other relevant materials
- Interviews with major related participants, including top managers of the hospitals, and senior management information systems (MIS) staff
- Reviewing recent publications and brochures of firms that manufacture or implement RFID devices.
- Visits to the sites where RFID devices were installed
- Establishing a case study references and reports database

Throughout this research project, Several RFID applications in Saudi hospitals were addressed. These include:

- Tagging of new born children in hospital
- Assets tracking to help locate and manage portable machines and other equipments.
- Reducing medical errors and enhancing patient safety in clinical process such as blood transfusion, etc
- Patients monitoring : to track patients throughout the hospital facility
- To collect health-related data in daily environments such as drug pedigree, to overcome the problem of counterfeiting

Details of some these applications are discussed in what follows.

2 RFID INFANT TRACKING AT RIYADH ARMED FORCE HOSPITAL

The Riyadh Armed Forces Hospital (RAFH) is a 770 bed hospital and located in Riyadh City, The capital of Saudi Arabia. It's the flagship of the Medical Services Department of the Ministry of Defense and Aviation (MODA). RAFH was officially opened December 1978. RAFH provides a major portion of the medical services for the military personnel and their dependents in the Kingdom of Saudi Arabia through a full range of diagnostic and management facilities for patients ranging in age from the neonate to the elderly. (rkh.med.sa/RMH.Website/English/).

The institution has a reputation, both in the Middle East and in the West for the quality of patient care provided, annual symposiums and for the research papers published in most reputable journals. RAFH administration requires that the quality of services rendered and the general operating standards of the center to meet the United States Joint Commission on the Accreditation of Health Care Organizations (JCAHO) standards. In addition to providing excellent care for patients, the RAFH trains appropriately educated Saudi nationals for administrative, professional and technical positions through continuing education programs and specific training program for Saudi Nationals.

A full range of clinical services are provided by RAFH, including General Medicine, dermatology, Hematology, Neurology, General Surgery, Pediatrics, Orthopedics, Neurosurgery, Ophthalmology, Cardiology, Oncology, Nephrology, Plastic Surgery, ENT, Urology and Oral Surgery. The hospital also houses a large laboratory service and Nuclear Medicine Department.

Since 1981, other services are provided by RAFH, including Obstetrics, Psychiatry, Rehabilitation, Renal Dialysis and Extended Care. To further advance the health care services provided by the program, additional services are now fully operational such as Bone Marrow Transplant Unit, Artificial Heart Transplant Project, Magnetic Resonance Imaging (MRI), In vitro Fertilization Project and Linear Accelerator Project.

RAFH was among the early organization in the kingdom to introduce radio frequency identification technology in its health service. RAFH implanted RFID solutions for tagging of new born children in the hospital. Infant tracking is fatal to monitor newly born babies' movements and match them with their mothers. RAFH Riyadh Hospital has applied an infant and pediatric RFID security system that alerts staff members if a patient's ID tag is tampered with, or if that tag approaches an exit. The system enables employees to determine which patient triggered an alarm. In order to select the best system, various systems offered by different vendors, were

evaluated. The chosen system was superior in its band-cutting technology—which transmits an alert if a band is tampered with—and because RF technologies offered includes training and follow-up customer service.

The system consists of RF Technologies with RFID interrogators deployed throughout the women's and children's wing of the hospital, located on the main hospital building. RFID tags are deployed throughout the paediatric, obstetrics and infant intensive-care units, as well as to sound alerts if the tags approach an exit. The tag or bracelet is attached shut on a patient in order to operate. If a person attempts to remove the bracelet, thereby breaking the connection, the tag immediately sends an alert to area interrogators that transmit data to the server. RFID Technologies software interprets that information, enabling the system to sound an audible alarm at nurses' stations. In future improvement of the system, staff members throughout the wing can view computer screens to see which zone the patient is in, as well as that patient's identity.

Upon its application, the RFID system however, had several false alarms caused by human error. For instance, a patient may attempt to remove an infant's tag to readjust the fitting, thereby setting off an alarm. Such false alarms are treated by providing more education by the staff to patients regarding how to adjust the RFID fitting.

3 RFID APPLICATIONS AT NATIONAL GUARD KING ABDUL-AZIZ MEDICAL CITY

The Saudi Arabian National Guard (SANG) Health Affairs supervises and administrates King Abdul-Aziz Medical City, a 1025-bed hospital based in Riyadh the capital and the Central Region of Saudi Arabia. (hospitalsoup.com/listing/48187-national-guard-king-abdulaziz-medical-city). This hospital provides healthcare to SANG personnel, their dependants and other eligible patients and also provides academic opportunities, conducts research and participates in industry and community service programs in the health field.

SANG medical city hospital provide mainly primary care, but offer tertiary care services as well, and are fully equipped with highly sophisticated technology.(hospitalsoup.com/listing/48187-national-guard-king-abdulaziz-medical-city)

It includes new state-of-the art developments such as cardiac and liver center; 21 bed Intensive Care Unit (ICU), long term care/ rehabilitation,

outpatient dental service , emergency care, surgical and medical wards, and trauma centers. Other adult and pediatric services provided include: Obstetrics and Gynecology (Labor and Delivery, Oncology, Antenatal and Post Partum wards); Pediatric Oncology and Pediatric ICU, Neonatal ICU, Operating Rooms, and Ambulatory Care Center. RAFH was the first organization in the kingdom to introduce radio frequency identification technology in its health service. RAFH implanted RFID solutions for tagging of new born children in the hospital. The system implementation is similar to the one previously described at RAFH. Besides, SANG has adapted active RFID to help locate and manage portable devices and other equipments at King Abdul-Aziz Medical City Cardiac Center. Details of this follows.

3.1 Assets tracking at National Guard King Abdul-aziz Medical City

It is very common for medical instrument to disappear in hospitals. RFID solution is implemented to identify various small expensive devices at SANG center. The RFID vendor and solutions provider, worked with the SANG hospital to set up an RFID portal in its hallway, through which all devices leave Cardiac Center are moved, to other hospital sections. Now, if a tagged device is pushed through the portal, it detects the tag and sounds an alarm. At the same time, the portal captures the tag reads and communicates that information, to the Healthcare server application, which automatically alerts the appropriate personnel.

It is planned that RFID will also be used in future to keep tags on approximately hundreds of SANG hospitals expensive medical devices, such as infusion pumps, and expensive surgical probes that worth thousands of Saudi Riyals and can by mistake end up in the trash.

According to a SANG Health Affairs key official, SANG also plans to expand its use of RFID. The plan is to enhance RFID solutions further in Riyadh hospital, to upgrade IT infrastructure in all of SANG hospitals, and then moves RFID implementations to other SANG hospitals throughout the Saudi Kingdom.

4 PATIENTS MONITORING AT KING FAISAL SPECIALIZED HOSPITAL (BPORTAL.KFSHRC.EDU.SA)

King Faisal specialized Hospital and research center (KFSH&RC) which is multi-entity tertiary care hospital and one of the leading highly specialized healthcare institutions in the Kingdom of Saudi Arabia, has rolled out radio frequency identification technology to track hundreds patients files throughout its facility. The hospital is also planning to expand the system to include active RFID tag for real-time patient tracking, in order to remove inefficiency associated with bed allocation and inter-departmental communication, and improve patients' access for admission. Tens of smart node RFID interrogators will be deployed throughout the hospital, and Smart Tags will be added to patients' identification bracelets in order to track those individuals as they moved around the hospital facility. By knowing the real-time location of a patient, KFSH hospitals will be able to embrace other features and make more productive use of radio frequency identification, such as improvement of patient blood-handling process, monitoring patients' body temperatures, and for real time tracking and recording a patient's vital signs.

Blood transfusion errors have long been a source of concern for KFSHRC hospital staff as the blood-handling process contains a number of manual steps, which can introduce human error.

To reduce blood-handling errors at King Faisal Specialized Hospital, the hospital is planning to introduce a program to use (RFID) technologies verification to address the sources of human and systems error in the blood transfusion process. Working with their technology partners, the program will be implemented at the 894-bed multi-facility Riyadh Hospital, where each year hundreds of blood transfusions are delivered.

According to a KFSH head of IT department, the RFID system, after being fully implemented, is expected to provide a number of benefits, from increased staff efficiency to improved communication, faster bed turnover and reduced patient waiting times.

5 PROJECT INITIAL FINDINGS

The early findings of this research showed that Infant tracking at RAFH Riyadh hospital was very effective in monitoring newly born babies' movements and match them with their mothers. Ongoing monitoring will be carried out to assess data for this important RFID application over a longer time period.

The Assets tracking at National Guard King Abdul-Aziz medical City has already earned its keep. The RFID server successfully tracked a variety of expensive medical devices that got moved around or misplaced.

The patient files track throughout KFSH&RC facility, was also very successful and was able to effectively locate them immediately when required. Since its application, very few files were missed.

Upon completion, this research project is expected to have several important findings for implementation RFID applications in Saudi healthcare organizations. It will help to in finding answers to important issues arising from this implementation, including:

1. Penetration rate of RFID in Saudi hospitals
2. Evaluation of acceptance and resistance level of RFID from medical staff and health managers
3. Analysis of Patients users perceptions and behavior towards RFID
4. The influential factors in the decision-making of RFID adoption for Saudi healthcare organizations.
5. Security applications related to information stored in the RFID smart cards. (Juels, 2006).
6. Level of automation of Saudi hospitals clinical analysis laboratories using RFID (Florentino et al., 2008).

6 CONCLUSIONS

RFID experience a fast development and implementation and Saudi healthcare is predicted to be one of its major growth areas. In this paper, we surveyed several applications of RFID in Saudi health care facilities that helped in saving costs and resulted improvement of these hospitals patients safety and privacy.

The paper describes how this emerging technology are used in leading Saudi hospitals to build a smart infant tracking, for assets tracking application and the plan to implement RFID for real-time patient tracking and reduction of clinical errors.

Based on our findings, it can be easily concluded that RFID helps optimizing business processes in Saudi healthcare and improved its patient safety.

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