IJLSR (2015), Vol. 1, Issue 2 **Review Article**

IJLSR INTERNATIONAL JOURNAL OF LIFE SCIENCES AND REVIEW

Received on 03 January 2015; received in revised form, 21 January 2015; accepted, 30 January 2015; published 01 February 2015

RFID: IN THE WORLD OF HEALTH CARE

Fauzia Khursheed *, S. Hasan Saeed, N. R. Kidwai and Saifur Rahman

Department of ECE, Integral University, Lucknow- 226026, Uttar Pradesh, India.

ABSTRACT: The RFID (Radio Frequency Identification) is a decade old wireless technology based on radio frequencies and is a member of Automatic Identification and Data Capture (AIDC) family. Its first application was seen around in the year 1945, and in recent years numerous applications have been evolved and are practically implemented in approximately every field. The motive of this work is to survey the different applications in the present scenario in the field of healthcare.

Keywords: RFID, AID

Correspondence to Author:
Fauzia Khursheed

Department of ECE, Integral University, Lucknow- 226026, Uttar Pradesh, India.

E-mail: fauzia.khursheed@gmail.com

INTRODUCTION: Radio Frequency Identification (RFID) is based on storing and remotely retrieving information or data as it consists of RFID tag, RFID reader, and back-end Database [1]. RFID uses the electromagnetic field for the transfer of data to automatically identify and track products onto which the tags are installed. The basic working phenomenon of RFID is shown in **Fig. 1**. This is a wireless technology and is better than other AID devices such as barcode *etc*. as in this technology object can be tracked without any line- of- sight. RFID is an epic technology as it was used in World War II as an IFF transponder to identify whether the aircraft is of a friend or a foe and is still used to this day. RFID has evolved to be the most drastically growing technology of this era, or it may also be referred to as the technology of the 21st century.

QUICK RESPONSE CODE

DOI: 10.13040/IJPSR.0975-8232.IJLSR.1(2).34-40

The article can be accessed online on www.ijlsr.com

DOI link: http://dx.doi.org/10.13040/IJPSR.0975-8232.IJLSR.1(2).34-40

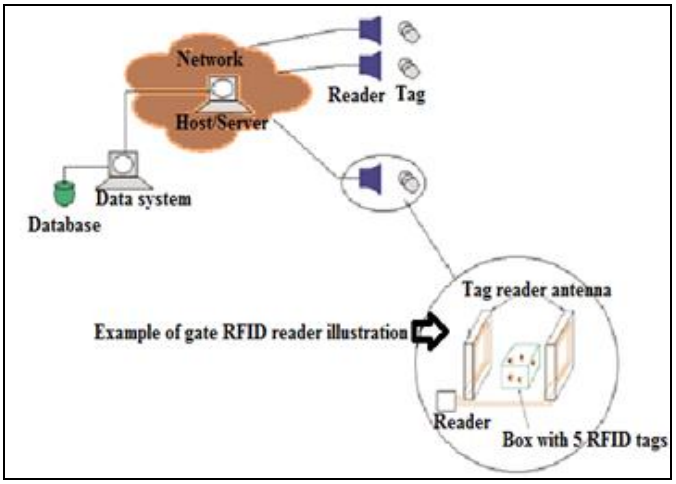

FIG. 1: WORKING PHENOMENON OF RFID

RFID is continuing to become popular because it increases efficiency and provides better service to stakeholders [2]. Applications of RFID are present everywhere, which accelerates the job and also make things easily accessible. Its application can be explored by simply placing tags to the objects, and the tags can be attached to any physical object, including medicine containers, hospital room equipment, vehicles, medical devices, envelopes, packages and even animals and humans [7]. RFID has found its firm applications in the field of

inventory, logistic controls, tracking, transportation, security, military, education, hospitals, health care, *etc*. **Fig. 2** shows the long range and short range application of RFID [3]. Besides, numerous of the advantage and application of RFID there still exist major privacy problem. Many researchers have addressed issues that are related to RFID reliability and capability [1]. RFID acts as a catalyst in the performance of various applications yet has to s prove its capability.

Research Framework: In this framework, the existing literature has been categorized into various sections. Where,

- Section 1 gives a brief introduction to RFID its working phenomenon, its applications, *etc*.
- Section 2 deals with the framework of the research work.
- Section 3 describes the application of RFID in health care, *i.e.* in medicines, treatment, clinic, hospitals, *etc*.
- Section 4 consists of conclusion and discussion.

The focus of this work was to identify the potential and role of RFID in mankind, *i.e.* health care and also the future world of healthcare under the RFID technology.

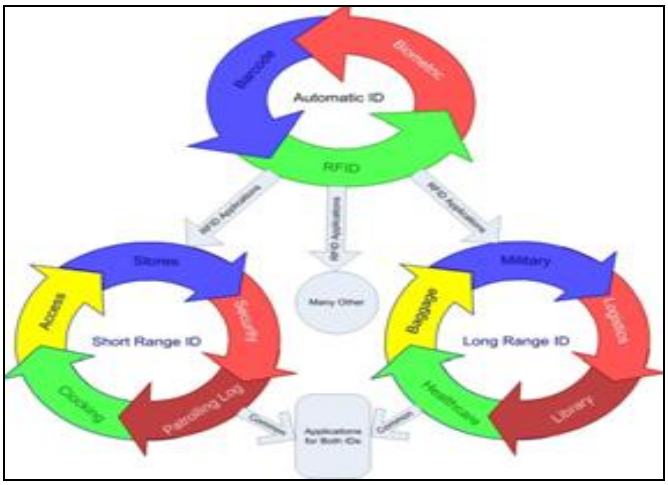

FIG. 2: APPLICATIONS OF RFID IN PRESENT SCENARIO [3]

Applications of RFID in Health Care: Today's health care system has a sparkling opportunity for increasing the use of RFID, wireless technology to improve patient care. From a physician's office to an operating room, wireless technology provides great potential for such services as medical device alarm notifications, surgical instrument, and hospital equipment tracking, and e-prescription writing. The RFID technology is emerging within the health care arena to improve patient care and efficiency of the hospital.

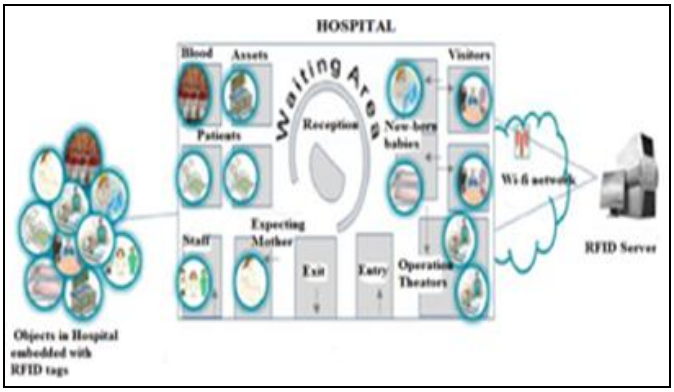

FIG. 3: OVERVIEW OF APPLICATIONS OF RFID IN HEALTH CARE (HOSPITAL)

In health care the use of passive tags are done which operate at frequencies 128 KHz, 13.6 MHz, 915 MHz, 2.5GHz and are applicable for both large area and small area, *e.g.* logistic control of the hospital, and movement of patients in hospital respectively and the role of small range application is more in health care. The application of RFID in health care can be classified into sub-headings as-

1. Asset management and tracking;
2. Patient tracking and identification reducing drug and blood administration errors;
3. Nutritional assistance;
4. Health management for the aged group.

Asset Management and Tracking: In hospitals, the main motive is to provide comfort and proper care to the patients. Therefore, to attain the best response, it is needed to manage the asset of all sorts whether to be medicines or various equipment like scissors, wheelchairs, *etc*. without any human errors. The RFID technology is resulting in ease of access to objects without any line-of-sight and thus making things smarter and better. The asset management in health care with RFID are used are as elaborated below-

Smart Cabinet: RFID installed in a medicine hall keeps the record of the stock of medicines by placing the tags on each medicines, syringes, *etc*. as shown in **Fig. 4**.

FIG. 4: SMART CABINET IN HOSPITALS

The use of RFID as smart cabinets (smart shelves 20)has made the medicine hall more accurate and smart as it can detect the expired medicine so that it cannot become harmful to any patient by keeping healthcare its priority and also remind on the shortage of medicines. The process of operating a smart cabinet is that firstly the users (staff/ nurses) identify themselves with a personal key card to open the door. Then they remove any item from the shelf. It's obvious that all items in the Smart Cabinet have RFID tags attached to them, and thus the Information is captured in real-time, so managers always know what they have in stock.

Smart Equipment: The real-time location service [8] is also provided by RFID which can be used by all medical staff in search of the medical asset. RFID tags are installed on each and every equipment whether be small or large (wheel chairs, IV pumps, instruments, beds, patient's file, high-value equipment *etc.*) it is basically done to track the location of the equipment in the hospital [5] and get it easily when required.

FIG. 5: SMART WHEELCHAIRS IN HOSPITAL

The RFID tags are installed on wheelchairs so that it can be easily accessed by the staff of the hospitals as shown in **Fig. 5**. Same is the task with other equipment and devices to check whether its free or engaged by making it easily accessible and accelerating the procedures so that it can be used as early as possible to secure the patient's health. The "Beth Israel Deaconess Medical Centre" in Boston is an example which uses such services of the RFID to keep track of their medical equipment [4].

Smart Cards: Staff is the biggest asset of the hospital, so its flow and management are very necessary. With the help of RFID based smart cards, the record of staff can be kept such as name, currier history, reporting time, whether present/absent and many more information as per the requirement of hospital. The use of the smart card in an organization also helps in locating the doctors/nurses so that patients can be examined on time. Smart cards can also be allotted as temporary ID tags to relatives and visitors verify an individual's status and areas of access – maternity, ICU, and so on [14]. Hospitals consist of RFID readers on the walls, lifts, so if the member of staff passes by any area under RFID interrogation zone, it records there movement, which makes it easier to locate them.

FIG. 6: SMART CARD ALLOTTED TO STAFF/ PATIENTS/ VISITORS

Patient Tracking and Identification: RFID tags can be built as plastic bands strapped on to wrists of patients (it may also be used by the doctors and nurses) [6]. These are used to track medication directly at the patient's bedside. It runs on a Pocket PC equipped with a dual RFID and bar code reader. The nurse scans the bar code on the medication package and RFID tags on both the patient's wristband and the nurse's identification badge. Updates or changes to a patient's medication order are available in real-time, providing the nurse instant access to those changes, and the system also

automatically charts each medication administration into the patient's Electronic Medical Record (EMR), saving data entry time and reducing the opportunity for human error. The RFID technology is used on the patient's wristband and the caregiver's ID badge as it does not require direct contact or line-of-sight. This technology helps to give correct medications to the patient on time and also maintains the proper prescription electronically by reducing the chance of destruction and displacement. RFID sensors have been used to monitor through wireless communication the heart-rates of cardiac patients [11], to identify patients for surgery [13], to help locate embedded devices (pervasive healthcare) [12] and to monitor the life of dental retainers [10, 9].

FIG. 7: WRIST BAND TO KEEP AN EYE ON HEALTH OF PATIENTS

Reducing Drug and Blood Administration Errors:

Smart Surgery Tray: Hospitals are getting smarter through the use of wireless technologies.

FIG. 8: SMART SURGICAL TRAY

The use of RFID in surgery tray has reduced the error more efficiently; this may be proved by the statement given by Adrianne Shepards on, manager of Maryland's Central Pharmacy Services- "An RFID scanner now does the work. A tray is placed in the machine and seconds later a monitor lists what's missing or dated which reduces delay". Such technology is very helpful in trauma centers and emergency cases. The figure8 shows the smart surgical tray.

Tracking Blood Bags: The occurrence of an error in the transfusion of blood is the major problem faced by hospitals which have become unacceptably frequent and severe. Mis- a transfusion of blood is the incorrect type of blood given to the patient due to the lack of identification, which may result in serious health problems and even death. According to [Sun05], mis-transfusions typically result from an error made during the bedside check just before transfusion. Studies have documented [Saz90] that such errors are most likely to occur among surgical patients [22].

Implantation of RFID tags in the blood bags may decrease the error rate by tracking every bags of blood, and by checking that the blood is given to correct patients. This is done by matching the information fed in the tag of the blood bag and the information in the wrist band of the patient. With the evolution of RFID technology in health-care, the overall process of managing blood bags is eased and is also time-saving. Most importantly, the risk of patients receiving the wrong type of blood is minimized.

Anti-counterfeiting of the Drug: Drug counterfeiting is very harmful and also effects in severe problems-

- Reduces the safety of the patient.
- Pharmaceuticals face the loss of millions per year due to counterfeiting supply of drugs.

This problem is being taken seriously, and in February 2004 the U.S. Food and Drug Administration (FDA) published a report [23] encouraging the use of RFID to combat it and urging the drug industry to adopt the technology [22]. The use of RFID technology (*i.e.*, tag, readers, antennas, and appropriate information systems) in making a world of anti-counterfeiting drug is possible by the unique ID of each tag which is recorded or traced by every transaction made. This technology keeps the transparency in all stages

from manufacturing to delivery, *i.e.* the whole supply chain is monitored resulting in the diminishing of drug counterfeiting and even thefts related to drugs.

Nutritional Assistance: The worldwide healthcare sector also includes nutritional assistance according to the public base on their dietary requirement, food choices, and diseases. The RFID based plate coaster can give the report of whether the patients are consuming right food or not based on the nutritional value of food to be consumed and it even checks the expiry date of food items in the plate. The RFID tags are utilized to access nutrition information for each kind of food in delivery to patients in the hospital, in old age home, residents, *etc.* as shown in **Fig. 9**.

FIG. 9: RFID BASED SMART PLATE

The technology is taken under use by placing food plate on a coaster with an RFID reader and built-in scale. The in-built miniature scale measures the weight of the food placed on the RFID based coaster. In addition, the nutritional information regarding food is read by the RFID reader from the tag in the serving bin of the hospital canteen. With the nutritional information of each item of food and the amount of particular item of food that is added to the plate, the nutritional intake of a patient can be calculated. After this process, the total nutritional information, including the amount of vitamins, calories, sugars, carbohydrates, and grams (g) of consumed fat in the meal can be obtained and tracked.

Health Management for the Aged Group: The health management in older age is very necessary as the patients' needs routine check-up and well-equipped room so that in case of emergency, any situation can be handled effortlessly. Chronic diseases are the greatest health threat faced by the elderly in an aging society [18]. Health monitoring using RFID technology is predicted as the next stage in home care due to its great potential as a low-cost and high patient-safety medical service [15, 16, 17].

The use of RFID in health care has made it easy to access the patient far from hospital/clinic; it performs the following functions-

- Provides the real-time monitoring of the patients' health,
- Keep on analyzing the vital signs at an early age and also predict the life-threatening diseases,
- Check whether they are following their prescribed treatment, including taking their prescribed medicine on time [19].

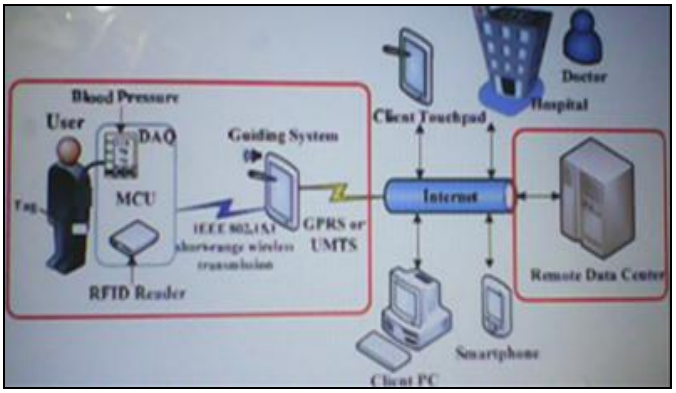

FIG. 10: BLOOD PRESSURE MANAGEMENT OF PATIENT AT HOME FROM HOSPITAL

Fig. 10 shows the setup for the RFID based BPMS (blood-pressure management system) of the patient of old age. This setup requires the use of internet, smartphone, touchpad, PC (personal computer), tag attached to the body of the patient, reader.

DISCUSSION AND CONCLUSION: RFID has been hailed as one of the twenty-first century's greatest contributions [9, 21]. It has turned to be a technology providing new capabilities and efficient methods for several applications, for example, in healthcare, access control, railways, sports, farms, agriculture, and food, *etc*. However from the above discussions it can be concluded that RFID has proved its evidence and efficiency in health care as it has become the reliable source for reduction in human errors in stock keeping (medicines, equipment, *etc*.), surgeries (to detect the sponge or

cotton left inside the body of patient during operation), medication, nutrition, billing, *etc.* RFID facilitates the adaption of location tracking technology in health care and shows the importance of real-time access. The use of RFID in biometrics, telemedicine, radiology, infection control, injection safety, *etc*. will be inherited by pharmaceuticals and hospitals in the future. RFID has resulted in the fruitful technology, and in coming years it will be adopted by many organizations to keep easy access over all objects.

ACKNOWLEDGEMENT: I would like to thank organizers of the national conference entitled 'Novel Tools and Treatment Approaches in Health Care System' for selecting my paper for poster presentation, organized at Faculty of Pharmacy, Integral University, Lucknow on 3rd March 2015.

CONFLICT OF INTEREST: Nil

REFERENCES:

1. Schwieren J and Vossen G: A design and development methodology for mobile RFID applications based on the ID-Services middleware architecture. IEEE Computer Society, Tenth International Conference on Mobile Data Management: Systems, Service and Middleware 2009; 38.
2. Bohn J: Prototypical implementation of location-aware services based on a middleware architecture for super-distributed RFID tag infrastructures. Pers Ubiquit-computing Journal 2008; 12:155-166.
3. Kamran A, Hanifa SH and Paul K: RFID Applications: An introductory and exploratory study. IJCSI International Journal of Computer Science 2010; 7(1): 3.
4. http://dr-health-informatics.weebly.com/current-and-potential-uses.html
5. Shirehjini AA, Yassine A and Shirmohammadi S: Equipment location in hospitals using RFID-based positioning system. IEEE Trans Inf Technol Biomed 2012; 16(6): 1058-69.
6. Xiao Y, Xuemin S, Bo S and Lin C: Security and privacy in RFID and applications in telemedicine. IEEE Communications Magazine 2006; 64-72.
7. Seidman SJ, Pantchenko O, Pantche Oxana S and Tennako D: Design of unique simulators to evaluate medical device susceptibility to radio frequency identification exposure. IEEE Electromagnetic Compatibility Magazine 2014; 3(1).
8. Rajo-Iglesias E, Polycarpou AC, Dimitriou A, Bletsas A, Polycarpou PC, Papaloizou L, Gregoriou G and Sahalos JN: On the design, installation, and evaluation of a radio-frequency identification system for healthcare applications. IEEE Antennas and Propagation Magazine 2012; 54: 4.
9. Nambiar AN: RFID Technology: A review of its applications. Proceedings of the World Congress on Engineering and Computer Science WCECS 2009, San Francisco, USA, Vol. II, 2009.
10. Brandl M, Grabner J, Kellner K, Seifert F, Nicolics J, Grabner S and Grabner G: A low-cost wireless sensor system and its application in dental retainers. IEEE Sensors Journal 2009; 9(3): 255-262.
11. Hu F, Celentano L and Xiao Y: Errorresistantrfid-assisted wireless sensor networks for cardiac telehealthcare. Wireless Communications and Mobile Computing 2009; 9(1): 85-101.
12. Yu-Ju T, Zhou W and Piramuthu S: Identifying RFID-embedded objects in pervasive healthcare applications. Decision Support Systems 2009; 46(2): 586-593.
13. Jeong BH, Cheng CY, Prabhu V and Yu BJ: A RFID application model for surgery patient identification. In 2008 IEEE Symposium on Advanced Management of Information for Globalized Enterprises, AMIGE 2008, 2009: 304-306.
14. Motorola: Application brief RFID in health-care "RFID solutions for Health-care reducing costs and improving operational efficiency.
15. Wang SW, Chen WH, Ong CS, Liu L and Chuang YW: RFID applications in hospital: a case study on a demonstration RFID project in Taiwan hospital in Proc. 39th Hawaii Int Conf Syst Sci 2006: 184a-184a.
16. Lahtela A, Hassinen M and Jylha V: "RFID and NFC in healthcare: Safety of hospital medication care in Proc. Second Int Conf Pervasive Comput Technol Healthcare 2008: 241-244.
17. Lee SY, Wang LH and Fang Q: A low-power RFID integrated circuits for intelligent healthcare systems. IEEE Transactions on Information Technology in Biomedicine, 2010; 14(6): 1387-96.
18. Lin CC, Chiu MJ, Hsiao CC, Lee RG and Tsai YS: Wireless health care service system for elderly with dementia. IEEE Transactions on information Technology in Biomedicine 2006; 10(4): 696-704.
19. Yang G, Xie L, Mäntysalo M, Zhou X, Pang Z, Xu LD, Kao-Walter S, Chen Q and Zheng LR: "A Health-IoT platform based on the integration of intelligent packaging, unobtrusive bio-sensor, and intelligent medicine box. IEEE Transactions on Industrial Informatics 2014; 10(4): 2180-2191.
20. Radio frequency identification (RFID) in health care benefits, limitations, recommendations A HIBCC White Paper, Health Industry Business Communications Council.
21. Mehrjerdi YZ: RFID-enabled supply chain systems with computer simulation. Assembly Automation 2009; 29(2): 174-183.
22. Guinard PFD: Building a Smart Hospital using RFID technologies. Reports of 355 transfusion-associated deaths: 1976 through 1985. Transfusion 1990; 30(7): 583-590.
23. McCue A: The hospital aims to cut operating errors with RFID tags, February 2006. [Retrieved March 26, 2006, from http://www.silicon.com/publicsector/ 0, 3800010403, 39156618, 00.htm].

How to cite this article:
Khursheed F, Saeed SH, Kidwai NR and Rahman S: RFID: In the world of health care. Int J Life Sci Rev 2015; 1(2): 34-40. doi: 10.13040/IJPSR.0975-8232.IJLSR.1(2).34-40.

All © 2015 are reserved by International Journal of Life Sciences and Review. This Journal licensed under a Creative Commons Attribution-NonCommercial-ShareAlike 3.0 Unported License.

This article can be downloaded to **ANDROID OS** based mobile. Scan QR Code using Code/Bar Scanner from your mobile. (Scanners are available on Google Playstore)