International Journal of Research in Engineering and Science (IJRES)
ISSN (Online): 2320-9364, ISSN (Print): 2320-9356
www.ijres.org Volume 9 Issue 8 ǁ 2021 ǁ PP. 01-06

Hospital Asset Management Using IoT and RFID

Rachana Kulkarni[1], Spoorthi Kulkarni[2]
[1]*Department of Computer Science and Engineering, JSSATE Bangalore, (Karnataka), India*
[* 2] *Department of Information Science and Engineering, JSSATE Bangalore, (Karnataka), India*
Corresponding Author: Spoorthi Kulkarni, Department of Information Science and Engineering, JSSATE Bangalore, (Karnataka), India

Abstract
In the magnificent era of digitalization, the healthcare industry has been focusing very importantly on the effort of enhancing inventory system through the incorporation with information and communication technology in the form of tracking the device data and data mining to make an ideal inventory management model. The jaunty emergence of the Internet of Things or IoT is the dawn of an era of the web enablement of the physical world. IoT explores new dimensions of patient care through real-time health monitoring, access to patients' health data and its involvement in hospital asset management. Radio frequency identification system (RFID) is an automatic technology and is used to identify objects, record data through radio waves. RFID with IoT is like the honey in a honeycomb. Hospital asset management and tracking has become one of the main priorities in healthcare as it saves hospitals both money and time. With the massive influx of patients, hospitals are under constant pressure to persistently track their medical equipment and supplies to make sure that they are properly utilised. The ultimate overview of this paper is to introduce two core technologies IoT and RFID as the chief proletarians of a hospital asset management system.

Keywords: *Asset Management, IoT, PDA, RFID, Tracking, Zigbee..*

Date of Submission: 05-08-2021 Date of acceptance: 18-08-2021

I. INTRODUCTION

The Internet of Things (IoT) shall be able to assimilate transparently and seamlessly a very large number of unique and miscellaneous end systems, while providing open access to selected prologue of data for development of a plethora of digital services. The concept of IoT is emerging as an important aspect in addressing the organizational and social challenges like health care management, environmental management, and many more. RFID which provides a unique identifier for an object is used in many industries like medical, logistics, maintenance, railways, etc. Radio frequency identification system is an automatic technology and is used to identify objects, record data through radio waves. Connecting RFID readers to the internet, the readers can identify and track the objects in real time. The IoT units in India alone are expected to reach USD 9 billion by 2020. The Internet of Things (IoT) has the capability to increase the connectivity of everything, everyone and everywhere, and is decreasing human efforts with increase in efficiency. When it comes to world rankings, India was ranked 145th among 195 countries on Healthcare Access and Quality (HAQ) index in 2016. One of the major applications of IoT is in hospital asset management and tracking. Healthcare field is a connected field in our lives which plays an important role in our wellbeing. In the recent years ,hospitals have been facing considerable expenditure pressure in the context of maintaining their medical supplies. With the steady rise of patient cargo in hospitals and major revision in healthcare policies along with the demand for these medical supplies is always rising high. On recognizing that poor inventory management mirroring the ineffective usage of organizational asset, and that fallible manual systems of past and present make it arduous to track medical equipment movement. Due to poor medical asset management contributing factors with lack of medical equipment ,supplies, beds ,wheelchairs, gloves, plastic vials and even staff and physician services. Hospital Asset management includes the management of all the physical assets of an organization along with their details like status, location, due dates etc. Hospital asset management and tracking has become one of the main priorities in healthcare as it saves hospitals both money and time. so now IoT based asset tracking system is mainly focused with the tracking of an assets in hospitals. while asset tracking is one of the best methods of tracking an asset either by tracking the RFID tags and reader by scanning the barcode upon the medical assets etc. The proposed iot asset tracking is developed to establish safety and security of the medical assets or people .the data stockpiled can be used for pattern forecasting conducive to (in order to) move inventory management towards achieving an optimal spread of available medical supplies and equipment throughout the hospital. the study of the available literature on IoT and RFID applications in the healthcare industry, asset

management in hospitals and forecasting methods for asset management is included in this paper .the Radio Frequency identifier consists of transmitter and receiver part .Transmitter is placed with the asset to be tracked ,which sends radio waves to the receiver. If the tracked asset switches out of the frequency range, an alert message or tocsin will be sent to specified guardians through IOT System for mobile communication. You don't need an epizootic, however predictable, for the public health system to crumple. It is a matter of routine that patients share beds with other and doctors are overworked day by day. Long before hospital staff notices a problem, the manufacturer or service vendor can perceive issues that need to be corrected. In the healthcare industry, hospital asset tracking is an effective way to meticulously monitor and manage healthcare equipment and supplies. One of the advantages is to install a management system, is that hospitals can closely analyse the asset lifecycle. This can include the process of planning, acquiring, deploying, maintaining and eventually disposing of physical assets. Lack of monitoring and alerting systems is the root cause for the delay in treatment time which eventually is leading to death during the Covid-19 pandemic. According to a survey, poor care quality leads to more deaths than insufficient access to healthcare--1.6 million Indians died due to poor quality of care in 2016, nearly twice as many as due to non-utilization of healthcare services (838,000 persons). Almost 122 Indians per 100,000 die due to lack of hospital assets and resources each year. And therefore, the ultimate overview of this paper is to introduce two core technologies IoT and RFID as the chief proletarians of a hospital asset management system.

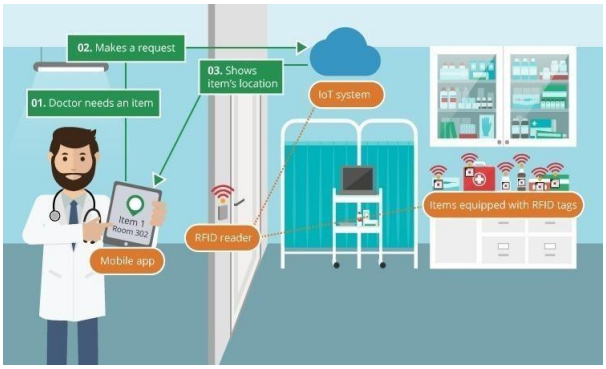

Figure1: The Asset Tracking system.
Courtesy: Boris Shiklo, RFID and IoT: A smart symbiosis for hospital asset tracking and management.

II. MATERIALS AND METHODS

A RFID device simplifies asset tracking and makes itself available to new markets and applications. RFID tag is a small chip with an antenna. It can be monitored with a trans-server. Every moment of the RFID tag crossing the transceiver will be recorded. Thus, complex linguistic process can be closely monitored. Once the surgery is complete, the tags on the products enable us to know which labels are used and discarded.
The basic IoT architecture has been depicted in the following five layers :
1. Perception Layer is responsible for identifying and collecting information from the IoT device for reading RFID tags.
2. Network Layer is responsible for transmitting the data generated by IoT device and its communication with a local server.
3. Middleware Layer is responsible for processing, managing and storing the data generated by the IoT device.
4. Application Layer is responsible for providing the data generated by the IoT device.
5. Business Layer is responsible for presenting the data generated by the IoT device for user interaction.
Although the implementation of RFID sensor is possible in hospitals, we are emphasizing in tracking reusable sharing assets. Reusable asset is divided into two categories:

Queuing assets: Patients can wait for their turn for assets such as portable X-ray, bed and wheelchair and use them for a shorter period of time. Also, these assets can be shared with one or more departments and hospitals.

Non-queuing Assets: Such assets serve as the most difficult type to manage in hospitals due to their small size and critical need for the patients. These assets are required to have enough supply in the hospital and will be with the patients as long as the treatment is completed.

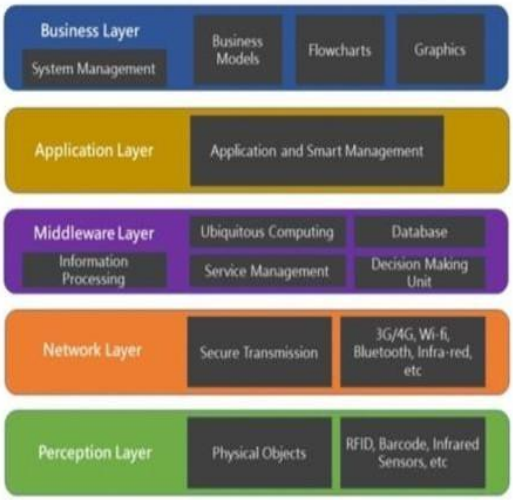

Figure 2: IoT Architecture
Courtesy: Yago Luiz dos Santos and Edna Dias Canedo, On the Design and Implementation of an IoT based Architecture for Reading Ultra Frequency Tags Rerun column Design specifications

Depending on the size of a hospital, queuing assets may be shared by the complete hospital or by a set of departments within the hospital. Thereafter, each asset unit must have an associated department list to which the asset can belongs , so that only the personnel at associated departments can see a given asset unit via RFID locators. This methodology allows logical partitioning of the asset pool between hospital departments. The suggested RFID system is focusing on the Queuing assets as the movements of these assets are easier to Track. When the infrastructure of the system is ready, the meta-data like access time, location and conditions of the assets will be collected automatically through IoT middleware. The IoT middleware operates as a smart agent. On the one hand, the IoT devices connect and send the raw data to the middleware, and the middleware then passes the data to the back-end system after performing data pre-processing (e.g. aggregation, filtering and normalization). On the other hand, the back- end system is able to configure and control the IoT devices in a straightforward way through the middleware. Apart from the data that is provided by IoT devices, another information sources is the professionals themselves, such as doctors, nurses and organization operators. In the healthcare industries especially hospitals and the nursing homes, unexpected or emergency conditions may occur at a high rate. A computer system so might not react to these conditions instantly or appropriately. Therefore, the proposed system provides a GUI for professionals to finetune the asset demand forecasting result based on real situations, using their professional knowledge and experience. Professional judgements are considered via editing and adding fuzzy rules into the system, and the new rules can be executed instantly. This approach helps to rarefy the result for decision support and enable better reaction in the unexpected conditions. RFID provides the opportunity to manage large inventory of medical equipment in a busy acute hospital. A central pole of medical devices is managed in the medical library. In a typical hospital, the medical library will have around 1000 medical equipment and processes around 2000 equipment loans each month. It is a pretty busy place and it is undoubtedly important to know where everything is. Each medical device has a tag attached to it which transmits an unique identity several times a minute. These devices are known are radio frequency or RF tags. On the hall in the library, there is a fixed-point RF reader which is connected to the hospital network and receives signal from each active RF tag and instantly updates the central software. A location search can be performed from any local PC using the web-based application allowing a remote user to verify what equipment is currently in the library. Consider a loan request for an infusion pump from a particular ward. So before the equipment is taken from the equipment library, the RFID discovery PDA(Personal Digital Assistant) is picked. The PDA is a mobile data collection device fitted with a compact flash RF reader and it can detect active RF tags that are up to 18 meters away. The infusion pump is then taken out for delivery. Before delivery, the ward name is selected from the drop-down list in the PDA. The discovery system then records local time assets against the location. The location is traced and the infusion pump is delivered. The location of this equipment is then updated and recorded. Other equipment are also traced through the PDA and therefore in the software database. This gives information where a medical device requires urgent attention like an annual service or a manufacturer recall. It is a useful aid to keep a safe patient environment and helps in keeping equipment location records up-to- date. One of the most advantage of the RFID system is its ability to see through cupboards and workstations. This also means that it can collect information about the equipment at effortless speed from locations that cannot be accessed physically such as behind patient privacy screens. This ensure each visitor

ward is effective and all equipment is recorded. To finish, the data is then posted which immediately updates all the information collected onto the central software. Users of this technology have already recorded significant savings by performing equipment audits and a fraction of a time previously taken. One user reports auditing four wards in just 30 minutes whereas it used to take 2 days and now they ordered 54 locations across the hospital site within one week.

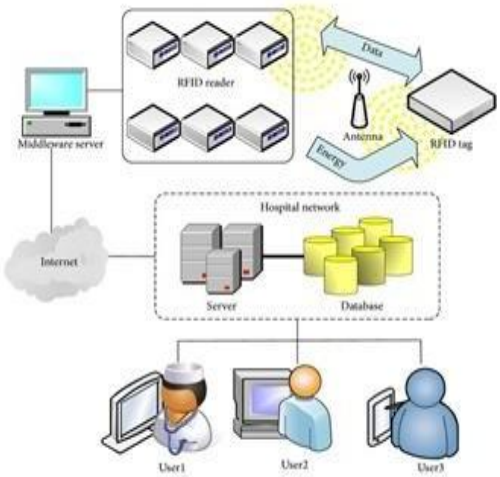

Figure 3: Functional component of the RFID System using in medical environment.
Courtesy: Lun-Ping Hung et al, Building a Smooth Medical Service for Operating Room Using RFID Technologies

The methodology architecture is depicted as above. A middle server such as the PDA acts as a communicator between the hospital network cloud and the RFID reader. Once the RFID tag is detected in the given range, the information is read by the RFID reader through subsequent exchange of data and energy via the internet. The information from the middleware server is then updated in the database through the server in the hospital network. The updated information is then sent to proficient users.

Analyzing the overall functioning of the software and its connected components, a flow chart containing the basic flow of procedures can be concluded. Initially, a loan request is given for a required or a misplaced asset. If the essential asset is not misplaced or is obtained at the current position, then the treatment is considered to be continued. Else, the location of the asset is found using the Asset Identification RFID Tag. The ID on the tag is compared with the GS1 ID numbers and the procedure is followed by Patient Authorization. If the authorization is unsuccessful, then the overall procedure ends or a retake on the entire procedure is performed. However, if the patient is authorized successfully, a deep search is initiated in successive departments. If not found, the search is further sent to the nearby clinics and health centers. If the asset is still not found, the search function is reinitiated with rescan of patient ID and the procedure continues. On the other hand, if the asset is found, the new location of the asset is updated and the confirmation of receival is sent.

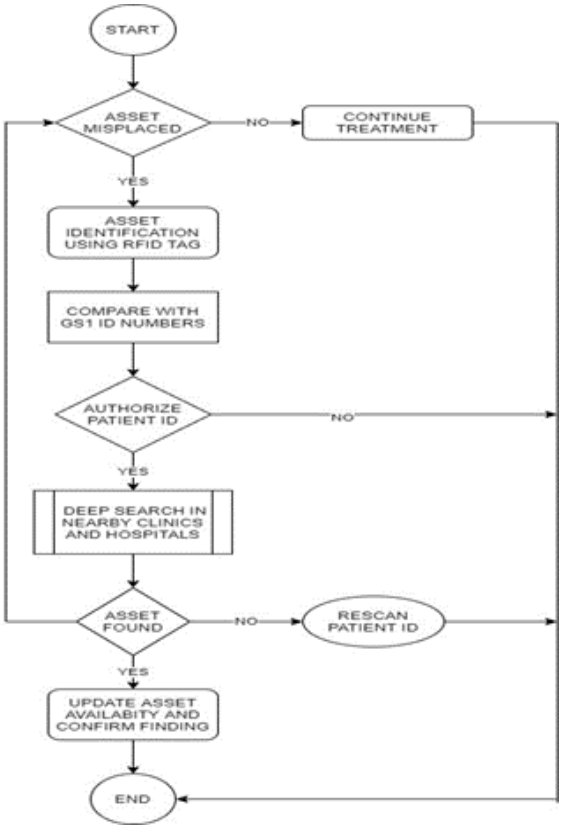

Figure 4: Procedure Flow Chart

III. RESULT AND DISCUSSION

Hospitals can be huge and winding mazes of people which contain enormous amount of systems and medical equipment that are necessary for running an effective healthcare facility. Hospital asset management involves Managing and maintaining physical asset within a hospital in the most efficient and cost-effective way possible. This paper has presented the optimization of asset tracking in hospital management and as to how IoT and RFID can maintain the efficiency of a hospital belonging. Items in hospital are equipped with tags.

RFID tags can be attached to the asset or embedded into them readers located in hospital send the info about the location the asset when a certain item is needed a doctor or nurse makes a request.

As one of the key technology trends in the era of digital transformation, the Internet of Things (IoT) is expected take huge strides forward in the coming years, with nearly 50 billion devices/things predicted to be connected to the internet by the year 2020, up from 7 billion in 2008.

Lee Carman Ka Man, Cheng Mei Na and Ng Chun Kit from the department of Industrial and Systems Engineering, The Hong Kong Polytechnic University proposed IoT based Asset Management System for the healthcare industry and it was developed based on Artificial Neural Network and Fuzzy Logic, to optimize the supply of resources.

Samuel Fosso Wamba and Eric W.T. Ngai in International Journal Biomedical Engineering and Technology [2013] in their study they have assessed the importance of the advantage of RFID in healthcare sector and its impact on healthcare asset management.

Nawaf Algarve, Anthony S.Atkins and Akbar Seikh Akbari at Proceedings of International Conference on Advances in Mobile Computing & Multimedia outlines the application of ZigBee and Radio Frequency Identification (RFID) technologies using the IoT in healthcare environment. The ZigBee is used to detect and locate an object and RFID is used to identify the door positions of an object at a designated floor level.

Vijey Thayananthan from King Abdulaziz University Saudi Arabia at International Journal of Advanced Computer Science and Applications in his research paper he has discussed about E-Health application and healthcare services using Information and Communication Technology (ICT) and Radio Frequency Identification (RFID) Systems and IoT based 5G and latest technologies

IV. CONCLUSION

An IoT system finds the nearest available item and informs the user about its location. Hospital asset management ends the cycle off Hoarding, Misplacement and Theft of assets, and effectively track medical carts,

crash carts and other assets that can be hoarded or misplaced. And also plays an important role in Healthcare Facilities, Patient and Personnel Tracking, Proximity Detection. Finally, the reform of our healthcare system should be undertaken in the same spirit of continuous improvement and renewal which can be a keystone towards success of our country.

The designed system has sophisticated healthcare facilities. The profound changes required for effective reform, even when the nation builds on the existing strengths of its healthcare system. The abiding focus is on the concerns of the people whose health and wellbeing we seek to improve.

V. FUTURE SCOPE

IoT and RFID have been the best patent technologies to serve the medicine field in the best efficient way.

However due to rapid sophistication in technology, there can always be an advancement. The future of healthcare includes technology that seamlessly combines data on a patient's medical history, real-time health, etc. Artificial intelligence has the ultimate potential to redesign healthcare sector completely. AI algorithms have been able to mine medical records, design treatment plans and create drugs way quicker than any current actor on the healthcare palette.

Artificial Intelligence with Machine Learning will definitely change the face of Healthcare Management. Development of advanced hospital assets improvises the overall quality of the supply chain network, therefore strengthening the market position.

Additionally, implementation of stringent laws and regulation by local authorities such as FDA allows an efficient and safe asset management for number of diagnostic and health monitoring equipment and eliminates the risk of drug counterfeiting which in turn positively affects the market growth in the recent years. The legitimate increase in the use of RFID tags enhances the overall quality of supply chain network and eliminates the risks associated with development of the fake drugs in the global market essentially thus leading in significant demand of tools for hospital asset management in the recent years. Moreover, the growth in the influence of the advanced technological solutions such as integration of Zigbee devices and smart active labels are considered as the important aspects that are driving the market growth in last few years. Also, rapiduse of automation and wide spread integration in finding for digital solutions in healthcare and pharmaceutical industry helps to improve overall quality of life for patients, and provides required safety.

REFERENCES

[1]. Shubham Banka et al, 2018 "Smart Healthcare Monitoring using IoT", International Journal of Applied Engineering Research (IJAERV) ISSN 0973-4562 Volume 13, Number 15

[2]. Raghavendra K K et al, June 2018 "An IoT Based Smart Healthcare System Using Raspberry Pi", Internal Journal of Research and Scientific Innovation(IJRSI),Volume V, Issue V1 ISSN 2321-2705

[3]. Sangle Sagar D et al, April 2017, "IoT Based Health- Care System Using Raspberry Pi", International Research Journal of Engineering and Technology(IRJET), Volume:04 Issue:04 ISSN: 2395- 0072

[4]. Dr.S.Brinda et al,March 2020, "IOT based Asset Tracking System", International Research Journal of Engineering and Technology(IRJET). Volume:07, Issue: 03 ISSN-2395-0072

[5]. B.N.Karthik et al,2018, "Survey on IOT & Arduino Based Patient Health Monitoring System" International Journal of Scientific Research in Computer Science, Engineering and Technlogy, Volume:3 Issue:1 ISSN- 2456-3307

[6]. Lei Yu, Yang Lu, XiaoJuan Zhu , October 2012, "Smart Hospital based on Internet of Things", Journal of Networks, Volume 7 Number.

[7]. L. M. Ni, D. Zhang, and M. R. Souryal, "RFID-based localization and tracking technologies," IEEE Wireless Communications, vol. 18, no. 2, pp. 45–51, 2011.

[8]. D. M. Konidala, D. Kim, C. Y. Yeun, and B. Lee, "Security framework for RFID-based applications in smart home environment," Journal of Information Processing Systems, vol. 7, no. 1, pp. 111–120, 2011.