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Hospital Management System Using RFID

S. Aswini Prathiba[1]
B.E. Computer
I[2]IT
Pune, India

Divya Jain[2]
B.E. Computer
I[2]IT
Pune, India

Abstract: ***Hospital Management system is a wholesome system that manages and automates the functioning in the hospital. The system is intended to reduce the manual intervention to the utmost level possible. This system uses RFID tags to secure access. It also enables efficient positioning. Identification of patients who are unable to communicate is done efficiently by the use of RFID cards. The two major issues looked upon in the proposed system are: Finding the doctors under emergency situation and Digitalized prescription. The doctor's position is recorded in accordance with the reader that has read the tag most recently. Prescriptions are uploaded to the medical record of the patient in the hospital database. It can be accessed using RFID of the patient. They can buy drugs or take a printout of this prescription from the drugstore of the hospital. This paper gives a brief design of the hospital management system using RFID.***

Keywords: RFID, Hospital Management System, Positioning, Digital prescriptions, access control

I. INTRODUCTION

Software Engineering enables the construction of reliable services, which plays a crucial role in Hospital management. RFID technology enables unique identification which enables efficient identification, positioning, and tracking of objects.

There are more chances of erratum in the medical records in a manual system. Managing and organizing records becomes chaotic. It is very important to maintain efficient software to handle information in a Hospital. There is need for an application that provides a way to record this information and to access them in a simpler way. The UI designed will keep in mind the much needed simplicity. The main purpose of our system is to make information management task easier and to develop software that replaces the manual hospital system into automated hospital management system.

Unlike a barcode, the RFID tag does not necessarily need to be within line of sight of the reader, and may be embedded in the tracked object. A line of sight is not required – tags can be read automatically, even through packaging materials and in transit, whenever moving items or people come within range of a reader. RFID systems greatly streamline inventory and asset tracking, virtually eliminating human error while providing instant, detailed records of the movement of assets.

RFID technology provides the information needed, as often as we need it, at a justifiable price.

The staffs of the hospital become tumultuous under emergency situation to find doctors. The current system doesn't provide any information regarding where the doctors are. The sale of drugs without prescription is one another problem at hand.

Several technologies for locating and identifying assets exist today and each has its place. For tracking we can either use Bar codes or RFID and for positioning we can use GPS or RFID.

Comparison of RFID with these technologies clearly yields the differences:

» Comparison of RFID and Barcode

	RFID	Barcode
Line of Sight	Not required (in most cases)	Required
Read Range	Passive UHF RFID: - Up to 40 feet (fixed readers) - Up to 20 feet (handheld readers) Active RFID: - Up to 100's of feet or more	Several inches up to several feet
Read Rate	10's, 100's or 1000's simultaneously	Only one at a time
Identification	Can uniquely identify each item/asset tagged.	Most barcodes only identify the type of item (UPC Code) but not uniquely.
Read/Write	Many RFID tags are Read/Write	Read only
Technology	RF (Radio Frequency)	Optical (Laser)
Interference	Like the TSA (Transportation Security Administration), some RFID frequencies don't like Metal and Liquids. They can interfere with some RF Frequencies.	Obstructed barcodes cannot be read (dirt covering barcode, torn barcode, etc.)
Automation	Most "fixed" readers don't require human involement to collect data (automated)	Most barcode scanners require a human to operate (labor intensive)

» Comparison of RFID and GPS

	RFID	GPS
Position location	Uses RFID reader's ID to identify the location for particular RFID tag	Uses global positioning system of 24 satellites. Using the data from multiple satellites, receivers can then triangulate their position relative to the satellites, and thus on the Earth's surface.
Transmission	Uses radio frequency	Uses radio frequency
Signal Strength	Weak signal strength, easy to jam	Strong signal strength
Accuracy	Accuracy depends on the number of readers used and the location is specified by the reader's exact location	It gives poor accuracy as it can only give the coordinates on earth's surface but not the altitude

TABLE 2: Comparison of RFID and GPS

II. Related Work

Radio Frequency Identification (RFID) is a technology which has recently attracted the interest of the research community because of the extraordinary benefits it offers over the other existing identification and data capturing technologies. Since the growth of RFID technology from 1900's, apart from its stated positive aspects, the technology also bears some concerns or issues [1]. Achieving a high operational efficiency in the health care sector is an essential goal for organizational performance evaluation. Efficiency uses to be considered as the primary indicator of hospital performance [2]. From a managerial perspective, understanding the hospitals cost structure and their inefficiency in utilizing resources is crucial for making health care policies and budgeting decisions. The cost of medical services in hospitals is likely control by higher operational efficiency and to provide more affordable care and improved access to the public [3]. RFID is one of the emerging technologies offering a solution, which can facilitate automating and streamlining safe and accurate patient identification, tracking, and processing important health related information in health care sector such as hospitals [6].

Since RFID is expected to help reduce costs for hospitals, sales of RFID technology for supply chain applications are expected to grow from $94.6 million to about $1.43 billion in 2019, with more than half of this expense coming mostly from hardware such as tags, readers, and antennas, and the rest from software and services. Several interesting examples demonstrate the benefits of the application of RFID technology. The Memorial Sloan-Kettering Cancer Centre in New York has been using this technology since 2007 to assess inventory and has expanded its utilization for both asset tracking and workflow by using active RFID to locate wheelchairs and stretchers as well as infusion pumps to determine if they are in use or not.

In a 2010 study in the radiology department of Massachusetts General Hospital, 13 RFID units were installed within two interventional radiology (IR) rooms to store and track inventory assets such as catheters, coils, stents, and other implantable devices. The hospital was able to confirm the need for and cost-effectiveness of RFID technology for supply management within IR and other departments. Because the RFID system has the ability to remove human factors from the clinician workflow as well as eliminate manual cycle counts needed to reconcile usage against actual on-hand inventory, hospitals can achieve increased charge captures, reductions in stock outs, and increased cash collection.

An additional benefit is the increased security of patient privacy, which is very important for the future growth of RFID in the hospital industry. Unless a traceable asset could somehow be associated with a patient and/or the patient's data (e.g., a newborn and the newborn's bed) in violation of HIPAA or other legal and regulatory requirements, RFID asset tracking poses little, if any, threat to patient privacy because assets, not patients, are traced. Furthermore, RFID improve privacy protection through the use of universal re-encryption schemes for tags.

Finally, the VA started a $550 million RFID project to equip all 21 of its Veterans Integrated Service Networks, which consists of about 152 medical centers. The RFID system includes a mix of active (mostly Wi-Fi based) and passive tags to be used in asset management, supply management, temperature tracking, and surgical instrument sterilization flow management in addition to "passive RFID tags for the 63,000 cardiac catheterization lab supplies consumed annually by the seven hospitals."

But in the existing Hospital management system, no effort has been taken on keeping record of staff location which is crucially important under emergency situations. No system has enforced use of digitalized prescriptions.

Problem Statement:

This system aims at simplifying the task of locating the medical staff in the hospital premises so that they can be informed and called upon in case of emergencies. RFID technology is used to implement this system. The digitalized prescription of all the admitted and visiting patients is stored in the database with respect to RFID cards. The patients are given medicines only through their cards from the drugstore present in the hospital. The system also allows patients to print the digitalized prescription for future reference.

III. METHODOLOGY

The automated Hospital management system consists of RFID tags, RFID readers, local server and easy to use User Interface.

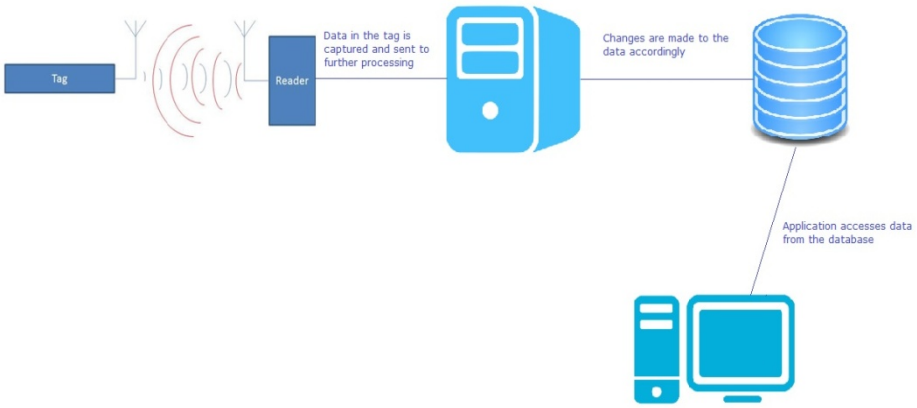

Fig 1: Architecture of Hospital Management System using RFID

Passive RFID tags will be primarily used for patient identification and drug authentication while active RFID tags will be mainly used for the tracking purpose.

Active Readers will be placed at different locations over the hospital area, in each department and every sector.

The RFID reader scans the tag and sends the tag information to the application that filters, analyses, and stores the data to the back-end database and then passes on useful information for further processing. The system will have multiple readers located in different places sending data through wired or wireless networks.

Every patient will be provided with an RFID card and his/her medical records will be maintained and monitored by the HMS. Patients can book appointments using their RFID.

Following are the main modules in the system:

A. Positioning

The readers will capture the data from the RFID tags and send it to the application along with the reader ID. The system will update the location of the corresponding staff member by changing his location in accordance to the reader ID in the database.

B. Digital Prescription

When a patient visits the doctor, the doctor can update the medical records of a patient only after double authentication i.e. the RFID of patient and doctor will be given to system and changes will be permitted only if the doctor's RFID matches with the doctor's ID in patient's appointment. The system will then provide an prescription form which the doctor has to fill and upload.

C. Drugstore

Sale of drugs can be done only when a digital prescription is available. Once patient's prescription is uploaded into the database, drugs will be sold at the drugstore using his RFID card. If the prescription was already sold, system will not allow the sale. Patient can optionally take a printout of the prescription at the drugstore.

D. Billing

Billing will be done by HMS in correspondence to the data stored in database for the RFID belonging to particular patient.

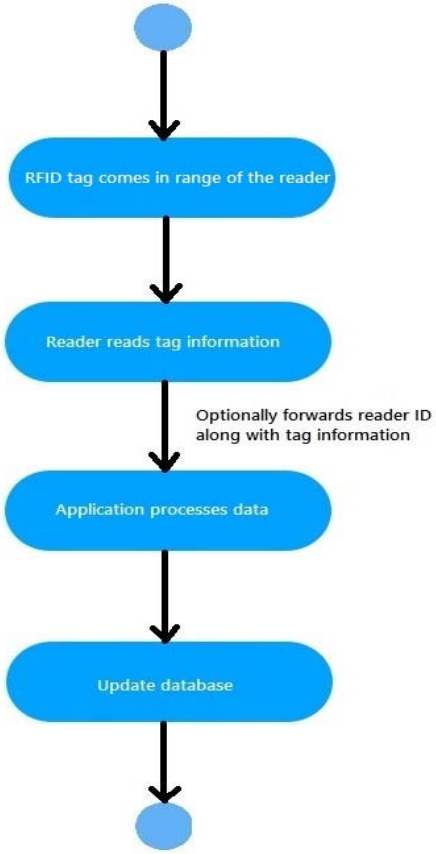

Fig 2: Basic flow of RFID based Hospital Management System

IV. MATHEMATICAL ANALYSIS

The system can be mathematically defined as:

S= {I, O, P, F}

Input set I can be defined as below:

I= {R_id, D_details, P_details, S_details}

Where,

R_id is the unique RFID reference number associated with each RFID card. This ID acts as identification number of the card holder.

D_details is the details of the doctor comprising their name, age, contact no., designation, specialization, working hours, their professional history and salary.

P_details is the details of the patients including their name, age, gender, contact no., doctor associated, medical history, billing details.

S_details is the details of the staff members working in the hospital which includes nurses, medical attendants, drug store employees, receptionist, accountant, cleaning staff, etc.

Output set O can be defined as below:

O= {L, B, P}

Where,

L is the location of the medical staff obtained while each time m they change their department.

B is the bills generated for the patients.

P is the digital prescription details generated which can be printed.

Functions of the system represented by set F can be defined as below:

F= {Tracking (), Billing (), Dgen ()}

Where,

Tracking () is the function which tracks the doctors and other medical staff.

Billing () is the function used to generate the bills for all the patients including all the details of the expenses.

Dgen () is the function which generates the prescription with all the details.

Tracking () function can be defined as:

Tracking () = {R_id, Did, Loc}

Where,

R_id is the unique ID of the medical staff.

Did is the ID of the department reader.

Loc is the location tracked.

We use search algorithm Time complexity= O (log (n))

Billing () function can be defined as:

Billing () = {R_id, S_no, D_f, T_c, R_c}

Where,

R_id is the unique ID of the medical staff.

S_no is the bill no.

D_f is the doctor's fees.

T_c is the test and other laboratory charges.

R_c is the room expenses if patient is recommended to get hospitalized.

Time complexity= O (log (n))

Dgen () function can be defined as:

Dgen () = {R_id, P_no, D_name, T_details, M_details, Diagnosis}

Where,

R_id is the unique ID of the medical staff.

P_no is the prescription no.

D_name is the Doctor's name and other details.

T_details is the details of the tests prescribed.

M_details is the medicines prescribed.

Diagnosis is the complete details of the patient's medical status.

Time complexity = O (log (n))

The System Majorly deals with Data Retrieval and Storage in the document oriented Storage. Document oriented storage stores independent document for each Patient, Doctor and other medical and non-medical staff. It also stores the details of the diagnosis and tests sample of each patient associating it with their unique RFID code.

V. Conclusion and Future Work

The product will be labeled Hospital Management System (HMS). The HMS will keep record of the current position of the doctors and surgeons. It will aid the staff to contact the required authority as and when required. The HMS will also maintain the medical records of the patients in the database. The HMS will identify the records with the unique RFID tag. The prescriptions will be generated digitally by HMS and the drugs will be sold only when these prescriptions are shown. The current manual method of management is time consuming and error prone. It is also difficult to manage the large paper flow involved in this process. The proposed Hospital Management System will allow hospital administrative staff to access relevant information efficiently and effectively. All of these sub-systems (positioning doctors, maintaining patient medical information, and digitalized prescription) need to be designed and implemented so that HMS can run effectively.

This generic architecture of health care system can be applied to other areas such as new born babies and aged-care management in both public and private hospitals where, healthcare providers (i.e., hospitals) will have an opportunity of using smart tag (RFID) for babies, to ensure that no misplacements happen. Having RFID tracking means hospitals can use RFID-based HMS to track whether infants are even inside the hospital that presumably is useful if they lose track of patients. The similar concept can be applied for the aged-care management using RFID-based HMS. In a future version of RFID-based HMS, we can explore the functionality to access patient's medical record from other healthcare providers through Internet. Finally, we are in the process of developing the functionality for accessing or updating patient records remotely by medical professionals/consultants using mobile devices like PDA/Smart phone. We can also make the HMS send automated emails reminding the patients of their appointments/check up schedule.

There is research in process on how RFID tag can be inserted inside human body. If a crack to this problem is found soon, the growth of RFID technology especially in the medical sector will boom tremendously.

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