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RFID in Hospital Management

Homi Limbuwala,

VP Business Development, SkandSoft Technologies

Medicine, as it exists today, segments care in specific domains – from the intensive care unit in a hospital to medicine chest in the home – each separate and detached from every other. In a modern hospital, for example, there are many different departments, each with varying degrees of monitoring and care, across a wide range of specialties. Within each department (neurology, obstetrics, orthopedics, pathology, pediatrics, radiology, surgery, etc.) patient records, registration, monitoring information and display information are not generally shared or provided in a common format.

In a typical Hospital environment Doctors, nurses and other hospital staff are provided with RFID enabled ID cards, also the equipment and assets in the hospital are RFID tagged. A wristband embedded with a RFID chip is issued to patients at the registration desk, which will carry information about the patient, such as name, sex, age, etc. since the patients' data will be kept securely in the RFID chip embedded in the wristband or linked to the medical history in the secure hospital database. The doctors and nurses can quickly identify patients and get the updated patient information via their PDAs or tablet PCs at the bedside within seconds in real-time and get rid of the manual paperwork which would in turn enable medical staff to intensify the level of care given to the patients and to

administer treatment easily and safely.

Many health professionals are concerned about the growing number of patients who are misidentified, before, during or after medical treatment. In addition, large medical facilities report that hardware such as wheelchairs and IV pumps go "missing" at an alarming and expensive rate. RFID can be used effectively to track and manage mobile assets and enhance healthcare workflow and business processes and are increasingly focusing on equipment management because it is a universal problem in hospitals. The RFID network in each hospital will be able to determine the exact location of all tagged medical equipment and other mobile assets. The system will also show whether each item is in use, available or in need of servicing.

RFID based Hospital Management systems may be used to track patients, doctors and expensive equipment in hospitals. It offers following benefits to Hospitals:

- Continuously track each patient's location,
- Real time tracking of the location of doctors and nurses in the hospital,
- Track location of expensive and critical instruments and equipment,
- Restrict access to drugs, pediatrics, and other high-threat areas to authorized staff,
- Monitor and track unauthorized

persons who are loitering around high-threat areas,

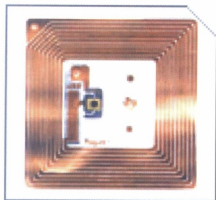
- Facilitate triage processes by restricting access to authorized staff and "approved" patients during medical emergencies, epidemics, terrorist threats, and other times when demands could threaten the hospital's ability to effectively deliver services,
- Use the patient's RFID tag to access patient information for review and update through hand-held computer (PDA)

"The future would have more and more business organizations access people, technology, funds and markets at par levels". The core differentiator that will define successful organizations of tomorrow will be getting relevant information in real-time. Organizations with critical and relevant real-time business information about their enterprise across multiple locations will be better equipped to face competition and emerge winners, said Mr. Kaushik Yegnan (MD/ CEO) SkandSoft Technologies.

Introduction To RFID

The object of any RFID system is to carry data in RFID tags (also called transponders), and to retrieve data by RFID readers wirelessly. The Middleware is the brains behind the system and sits between any data collection technology, like barcodes, RF, RFID, GPS, SCADA,

PLCs, Microprocessors, etc. the Middleware Collects and processes the data, which can then be send it to the enterprise application environments like ERP's (SAP, Oracle, etc.), HIS (Hospital Information Systems), BI, CRM, Reporting tools, etc. and can even enable feedback through machine to machine (M2M). The web-enabled solutions allow the Information to be accessed and acted upon in Real-time from anywhere.



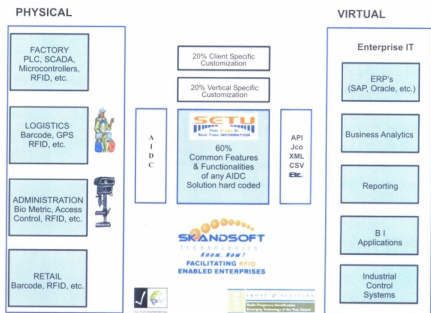
The new age RFID/AIDC middleware's like SkandSoft Technologies SETU™ are more than just a bridge connecting the hardware to the enterprise software. They facilitate multiple Solution/Application development like, asset management, visitor management, document management, ePharma, warehouse management (WMS), supply chain management (SCM), etc. The Middleware can even enable feedback, through machine to machine (M2M) interaction. e.g. If an unauthorized movement is detected the system can notify a PLC to lock the access point. Further, these web-enabled solutions allow the Information to be configured, monitored and managed in Real-time from one central location irrespective of the distribution of physical location.

RFID technology can be used for Identification & Location of tagged items

(man & material) through an electronic label or tag capable of transmitting data. With its traceability, the technology is a recognized alternative to applications in which the barcode has reached its limit.

electronic tagged to the electronically connected physical environments.

Typical Process Schematic



RFID is now a matured technology and is highly accurate; RFID enabled indoor location systems can provide accurate location information from a few meters for a standard RFID-RTLS system to as accurate as 6 inches for the UWB-RTLS (Ultra wideband Real-time location systems).

The internet of things is here; with our capability of attaching an electronic identity to a physical object like man or material effectively extends the Internet (virtual world) into the physical world, turning physical objects into an "Internet of Things" just like in the movie IRobot. By doing this we no longer require the human interaction to track humans, animals, assets, products, goods in our house, etc. These real-time applications will be able to see, track and to some extent even control all items like man and material in the network as they are

Process Flow Registration

- Patient enters the reception and fills out an Initial patient Record (name, address, complete contact details, emergency contact, passport no (in case of foreign nationals), etc., at the registration counter.
- The details on this form need to be keyed in only once into the system to reflect in the Hospital ERP
- After this the patient is given an RFID tag (e.g. wristband) which contains all the details of the patient
- Recording & retrieving of data is automatic since the RFID tag is read by the system and the entire details of the patient are available on a single click.

Billing

- The patient just presents himself at the billing counter.

- The RFID reader reads the patients tag and displays the entire details of the patient's stay in the hospital including ailment, Doctors, duration and type of the stay, ward charges, lab charges, OT charges, medicine costs, boarding expenses etc.
- All the above information is time stamped leaving no room for error and ambiguity
- Since the entire bill generation process is automated, considerable amount of time is saved for the billing staff and the patients.
- The patient's record and the assigned doctor's schedule are automatically updated for follow-up visits.

Outpatient Department (OPD)

- Patient goes to the assigned doctor's consulting room
- The patient is immediately intimated of his estimated wait time on a display which also displays the serial number of the current patient in queue.
- The Doctor has a RFID reader attached to a PC. This reader reads the patients details and displays them on the screen for the Doctor.
- Similarly when the Doctor keys in the specific patients details on his system, the RFID tag on the patient gets updated simultaneously, thereby ensuring that the patients RFID tag is carrying the most current and updated information for future reference.
- If there is need for the Doctor to prescribe some medication to the Patient, the Doctor keys in the prescription that is immediately reflected on the Pharmacy computer.
- The Patient is sent to the Pharmacy.
- The pharmacist reads the RFID tag, which brings up the patients ePrescription, the pharmacist gives the required medicines and updates

the patients records and RFID tag simultaneously – this information is useful while billing and in building a patients case history.

- The patient then reports to the Billing desk and clears any pending bills, the RFID tagged bracelet is removed and sent back to the registration counter after being sterilized.

- The test reports are automatically updated to the patient's database and prepares for further action.
- If the patient needs to be retested for any reason the System can immediately send an SMS or call the patients cell phone to report to the lab for a follow up test. • In a critical event the test results can be pushed



- The Patient is then issued a stamped receipt and exits the hospital after being cleared by the security where the receipt is checked.
- It is also easier for the OPD support staff to maintain their inventory since all their assets are RFID tagged and at a pre-determined frequency they have to just scan the area and the inventory is updated.

LAB

- Patient goes to the Lab
- The lab technicians scan the patient's RFID tag and the requisite tests needed are displayed immediately on their screen.

directly to the consulting Doctors cell phone / pager thereby saving precious time in critical cases.

- While leaving the hospital the system presents the entire case history and makes the updates to the master database making it easier to retrieve the data for future use and the patient is freed of the responsibility of maintaining his individual medical files.
- Since the data is stored on the web based system, the same can be accessed by any Doctor anywhere in cases of emergency.

Resident Medical Officer (RMO)

- RMO is the first point of contact for all emergency cases.
- In case the patient is a member of one of the group hospitals that share their secure patient database, the RMO doctors can immediately look up the entire medical history of the patient on their screens by accessing the web enabled secure patient database.
- This helps save vital time during emergencies.
- In the case of new patients, while the doctors are attending to the patient, the patient's details can be simultaneously generated by the system.
- While the patient is being attended to, their RFID tagged bracelet is also simultaneously generated and the patient is issued the RFID tagged bracelet and update.
- the patients family is requested to go to the Registration and complete the registration formalities.
- When the patient is stabilized and needs to be admitted to the hospital for further treatment, the system automatically assigns the patient a Ward and the patient is moved out of the RMO and the patients data is updated in real-time.
- The patient's relatives are spared the hassle of complying with the paperwork procedures.

Ward:

- While the patient is being transferred to the ward, system simultaneously pages/ SMSs the relevant doctors of the new patient requiring attention.
- The Doctor visits the patient in the ward; the system validates patient-bed-doctor combination automatically.
- The Doctor visits the patient and scans

the RFID tagged bracelet and the system displays the entire patient case history, medication and any change in patients condition, etc., the patient's last recorded temperature, BP, etc are also displayed automatically in real-time on the doctors PDA or tablet PC.

- The system also displays the medication and patients vital statistics and any change in patients condition, etc., the patient's last recorded temperature, BP, etc are also displayed automatically.
- The patient's vital statistics are continuously monitored & updated in patient records in real time. Any abnormal fluctuations, alerts the concerned staff member / doctor.
- The system alerts the doctor for any allergies. The system also alerts the doctor for any wrong/ mismatched medication allowing the doctor to even check the Medical reference for a particular drug, etc.
- The Doctor goes through the OPD report, directs the patient and / or relatives to the lab to take any further tests.
- After the tests the patient once again returns to his ward and awaits the test results and the further treatment.
- Once the Lab results are ready the patients records are updated and the doctor is notified immediately that the patients reports are ready, the Doctor logs in at any PC and recommends the appropriate treatment.
- Any further treatments or medication required is updated immediately in the patient database as well as on the patient's RFID tag the next time it is read.
- A schedule of doctors and supporting staff is created/ updated, along with the medication to be given as per

the schedule prescribed, special diet details. The assigned doctors and staff are updated with the schedule.

- The System automatically notifies the hospital pharmacy to immediately send the medication prescribed to the patient in the particular ward.
- As soon as the pharmacy issues and dispatches the drugs to the patient, the patients records are updated and billed accordingly.

Operation Theater (OT)

- The RFID readers installed in the OT provide real-time updates on the availability.
- Once an operation has been scheduled the system sends updates and alerts to the support staff, the nurses, the lead and the support Doctors.
- After the patient is brought in the OT the system validates the patient, type of operation and doctor details.
- The system allows entry to only the authorized and assigned staff and issues an alert if the particular staff is not present
- The system displays a checklist for the operation (equipment, medicines, etc).
- The Blood Bank, Lab and other relevant departments are automatically updated on the OT schedule to be prepared for any emergency.
- All the critical assets in the OT are RFID tagged thereby automating their tracking and management.
- All the equipment is accounted for at the end of the operation; equipment and medicines usage is recorded and updated.
- After an operation all the details of the operation are saved in the digitized file allotted to the specific patient, thereby easing any future

referencing.

- It is very important to track the OT assets are they are very expensive and need to be operational at all times.
- After the surgery the OT is sanitized and prepared for the next surgery.
- The moment the OT is ready for the next use, the system is updated real-time on the availability of the same.

Blood Bank

- The bank handles two types of consumers – donors and receivers.
- The blood donors are assigned a unique registration number which points to all the requisite details of the donor like name, address, contact numbers, blood group, date of blood donation etc.
- This registration number is unique and hence can be easily identified for any future use – like contacting the donor in case of emergencies etc.
- The registration number is written on the tag that is attached to the blood bag used for collecting the blood.
- After all the requisite tests have been done details such as date & time of collection, bag No., blood group, preparation start time, time of storage, storage temperature details, etc. are entered in the blood components register.
- Also the blood lab technician's details like name, etc. are updated to the RFID tag on the blood bag and the system simultaneously.
- After all the tests have been done the RFID tagged blood bag is stored in the refrigerator for future use. The RFID tag also contains a temperature sensor that tracks the temperature of the bag from the time of collection to the time its used by the patient.
- The system automatically updates the stocks of the various types of blood

bags stored within the bank.

- Since this data is web based it is easier to locate specific blood types across multiple locations.
- When a specific type of blood is requisitioned, the bank staff looks for the specific bag with a hand held RFID reader to locate the exact bag.
- This saves a lot of time and can be critical in emergencies.
- After the bag has been located, while it is being issued, the issuing authority's details like name, date of issue etc are updated on the tag and on the system as well.
- In emergency cases the Doctors can see real-time all the details of the tests that have been performed and can reconfirm the validity of the blood before it is used.
- Since the data is stored in a secure web-enabled database, the data can be accessed by any Doctor from anywhere in cases of emergency.

Warehouse

- All items in the warehouse can be RFID tagged.
- When the goods are received in the warehouse, after they have been checked manually the requisite details like the vendors details, date of purchase, date of expiry etc. can be stored on the tag attached to the items.
- After the items have been tagged, their movement across time and space within the hospital premises can be tracked on a Real-Time basis.
- Whenever any items are issued the details of that transaction are immediately updated in the system thereby reducing the scope of manual errors and nullifying the scope of intentional misuse.

- All requisitions and issues can be made paperless thereby saving considerably on the resources and the time spent in creating paper records, maintaining and retrieving them.
- All these activities happen seamlessly and since the WMS is connected to the hospital ERP real-time records are available for viewing.
- Automated emails / POs etc
- PO's are generated automatically as per set triggers, like minimum quantity levels, etc.
- Automated alerts to the relevant staff
- Automated escalation in case of inaction

IT/ ERP

- The system automatically updates all transactions in the ERP simultaneously. Hence the ERP displays real time information without any lag.
- All the IT assets are RFID tagged and their ownership defined. Hence tracking the various assets is automated.
- Also the system raises pre-defined alerts with the relevant people in case of deviation from defined ownerships.
- The IT department can have custom generated reports defining the warranty and the post warranty lifecycles of the various IT assets.

Identification and Location - Patients, Visitors, Hospital staff

The patient is the most important person in the medical facility. All efforts are focused on their treatment, recovery and eventual discharge. Just as the medical ID bracelet with barcodes have for years provided positive

identification for the patient, the new RFID enabled electronic bracelets are used to provide accurate, automatic and real-time identification of the person under medical care. Such an electronic identification system allows all patient information to essentially "follow" them wherever they may go within the facility.

The implementation of the patient-care application will improve accuracy, e.g. when it comes to administering drugs, the process will make sure that the right drug has been administered to the right patient at the right time with the right dosage prescribed by the doctor and also make sure that the patient is not allergic to the medication prescribed by the doctor. RFID based integrated OR (Operating Room) solutions also prevent the wrong surgery being performed on patients, which can carry very high liability on both the patients as well as the hospitals.

Another very important area for RFID based solutions is the high security Neonatal unit of hospitals where the newborn babies are tagged immediately with RFID ankle bracelets and associated with the mothers RFID tags, so that they are not switched. Also their blood cord can be RFID tagged & saved for later use. Only authorized personals with RFID enabled tags are allowed to visit the neonatal units.

Medical Device Localization

Most medical devices and monitoring systems are stored on portable carts. These carts move quickly from room to room in a hospital, but their location at any one time may not be known. Electronic tags in the monitors (and carts) and readers at the doorways would positively locate the equipment in a particular room. This should be

sufficient to quickly locate and retrieve the cart. These systems also track the maintenance done on the equipment. Also, surgical instruments can be tracked during surgery to make sure that they are not left behind inside the patients after surgery.

Administration

For the hospital administrator knowing the overall occupancy of the building, patient flow through facilities and general movement on the floors could help optimize resources and potentially cut costs. Resource limitations would become obvious and indications for future expansion or renovation would be validated.

The significance of the emerging technologies like RFID in the medical field will help the Hospital management to develop custom solutions that works best in their environment by mixing & matching all the available solutions that best fit their needs to provide their Patients with the proper care that they deserve and at the same time making sure that the cost of healthcare becomes more affordable and safe for the patients as technological solutions improves the efficiency.

Features

- o Single point of data entry for all transactions
- o Retrieval & replacement authentication
- o Real-Time location details of all assets and patients.
- o Customizable events/ alarms for
 - o Unauthorized access of inventory storage areas
 - o Delays in retrieving or replacing
 - o Unauthorized movement of patients
- o Alerts/alarms via e-mail, SMS, Pager,

user prompt, Beep or Flash.

- o Customized/ scheduled reports – can be sent over e-mail at scheduled time
- o Search based on Information requested, Requester, Date, Personnel, Information disseminated, Status etc.,
- o Solution built on a scalable platform – can be extended to any other application or business process without additions to the platform
- o Graphical representation of the storage locations

Benefits

Distributed Architecture

Distributed architecture provides largest physical coverage. SETUTM execution is distributed between the Clients and the Server to minimize dependency on single-node and to have contingency (e.g., if the network is down between server and client, client independently handles all the data till network comes up and the server takes over).

Single Hospital Location:

- o A single RFID tag carries the entire details of a patient throughout his entire stay in the hospital right from check-in to exit.
- o This makes it easier for both the patient and the hospital to maintain and retrieve records.
- o Benefits resulting from REAL TIME UPDATES across all the functional blocks of a hospital as enumerated in the "Technology Impact" sections above.
- o Real-time information on bed, assets, support staff, doctors, test-reports, drugs, etc result in a more efficient operation.
- o Enforce visitor management policy.

- o Enforce strict security in neo-natal wards
- o Enhanced security of assets and resources.
- o Enforce business processes across all functions.

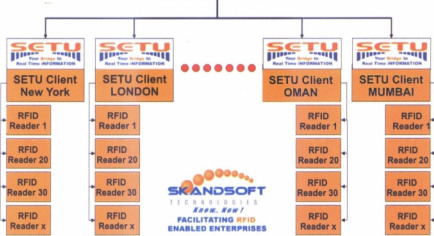
Multiple Hospital Locations:

- o Since the solution is web based, information contained in one location can be easily accessed by other locations thereby increasing efficiency.
- o Real-Time collaboration between various locations e.g. for a particular case, the expert doctor is in one location, his help can be taken online by some other location, thereby saving resources for the patient and the hospital resulting in an increased feel-good factor about the hospital.
- o Similarly in the case of surgeries the expert doctor in one location can guide the doctors in other location in critical surgeries.
- o Since business processes can be embedded on SETU™ this can help enforce uniform quality and operational processes across all locations.

Web-enabled

Web based, multi-location business control – All configuration, monitoring and management of all the hardware and software can be done remotely from one central location in real-time, irrespective of the distribution of physical location, different hardware vendors, protocols, standards used.

- Process definition, setting up events and actions can be done remotely over web e.g., change of an employee security status or a document's security status.
- Access to Reports – Custom reports can be designed on the fly by the management as required and can be access remotely. Role based portals allow customization of types of reports for various groups of end users.
- Centralization and distribution of real-time data like Patient history, employee records, equipment database, business process, compliance to government regulations, etc. across multiple industries like a chain of Hospitals, SCM, manufacturing, Government organizations, etc. ■



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