

The Marriage of Passive and Active Technologies in Healthcare

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Automated Identification Technologies in Healthcare

Automated identification technologies (AITs) include a variety of technologies such as RFID and barcodes that are used to identify objects. The benefits of using AITs are that they have the ability to increase efficiency and reduce data entry errors. Currently, AITs have commonly been used in access control and security applications in several industries. Such industries include those that must track products through the supply chain or manufacturing process or those requiring the identification of products at the point of sale or point of service [1]. With the success that AITs have seen in other industries, it is only natural to apply these technologies to the healthcare industry in order to improve operational processes and patient safety.

Until recently, barcodes have been the type of AIT that is predominately used in hospitals. Barcodes are typically used in medication administration where nurses scan the patient and the medication to determine whether the correct dosage is given to the correct patient. This AIT is recommended by several organizations including the Institute of Medicine, the National Patient Safety Foundation, the American Society of Health-System Pharmacists, and the National Alliance for Health Information Technology [2]. The advantages of this method are that it reduces possible medical errors and improves the hospitals operational ability. Figure 1 demonstrates the barcode system currently in place in many hospitals.

[INSERT FIGURE 1]

RFID: The Future of Healthcare

RFID is an AIT that uses radio waves to automatically identify objects. There are several aims of RFID but two of the most important ones are to reduce administrative errors and labor costs associated with lack of an efficient means to capture data. RFID operates on several frequencies: low-frequency (125 KHz), high-frequency (13.56 MHz), ultra-high-frequency (UHF) (860-960 MHz), and microwave (2.45 GHz). Each frequency has different characteristics, which in turn allows different frequencies to be useful in different applications. For example, low-frequency tags use less power and have the best ability to penetrate non-metallic substances in comparison with the other frequencies while high-frequency tags work better than the others on objects made of metal.

RFID systems consist of three main components: readers, antennas, and tags. The antenna emits radio signals that the tags respond to with their own unique code. The reader then receives and decodes the tag information and sends it to a computer through standard interfaces. Tags may be

categorized into three types: active, passive, and semi-passive. There are several differences between the types of tags. Active tags are battery powered which allows for longer read ranges and a greater memory capacity. One disadvantage of active tags is that they are typically more expensive than their counterparts. Passive tags have no battery and much less expensive than active tags, but their read ranges are significantly lower than their counterparts. Semi-passive tags are similar to active tags in that they have long read ranges and they are more expensive than passive tags. These tags utilize a battery to run the chip's circuitry, but draw power from the reader in order to communicate. The differing abilities of the types of tags allows for applications in a variety of areas within a hospital. The strengths of each type allow for better application in one hospital operation as oppose to the use of another with respect to cost and reliability. For example, passive tags would have significantly lower readability on high value assets such as wheelchairs than active tags.

RFID can commonly be utilized as a real time locating system (RTLS) when using an active system. RTLS allows for the tracing and tracking of assets. RFID vendors like Ubisense and Awarepoint allow for the location, status, and movement information of assets or people in a 3D mapping using RTLS. .

Passive Applications of RFID in Healthcare

Passive technologies are less expensive and are typically used in areas where it is not necessary to know the exact location of an item. RFID can be utilized as a healthcare information system for patient identification, avoidance of wrong usage of drugs, the warehousing of medical objects, and the prevention of counterfeit drugs according to a study in Taiwan [3]. Recent applications of passive technology include telemonitoring, which is being used by several hospitals to determine if outpatients are taking their medicine. Leap of Faith has developed an eMedonline platform which transforms a cell phone into a medication sensor. A smart label is used on the medication packaging. Data is collected wirelessly by the phone in real time and aids in the verification of drug consumption. Studies are being conducted on the use of this technology to help manage patients' compliance with their treatment in cancer patients [4].

Most hospitals and healthcare providers use this technology to track patients or medication. Many hospitals are implementing passive technology to track patients so that the correct patient receives the proper care. These types of systems reduce the data entry of nurses which in turn allows for more time caring for patients. Recently a company has introduced a SmartSponge system which prevents surgical sponges from being left in patients. Future research could expand this to other surgical items, not only sponges. Other applications include access control into buildings or labs.

Active Applications of RFID in Healthcare

Hospitals and healthcare providers are using RFID technology to track patients and high-value assets, as well as ensure patient safety. Hospitals have begun using active RFID systems to track high value assets, including wheel chairs, oxygen pumps, hospital beds, and IV pumps. Utilization of these systems reduces the amount of time that employees spend looking for these assets.

A Marriage of Passive and Active Technologies

The future of hospitals lies in a completely automated system. As discussed, RFID has seen success in various aspects of healthcare operations both in passive and active technology. By utilizing both technologies, a hospital can find a more cost-efficient and reliable manner to conduct their operations. Figure 2 depicts the various areas where RFID can be implemented.

[INSERT FIGURE 2]

The advantages of a hospital which is comprised of passive and active technologies lies in the financial benefits. Costly hospital equipment is often underutilized due to its misplacement. When equipment is misplaced or personnel are unable to locate it, oftentimes hospitals must rent or buy these high value items. Active technology eliminates the need for rentals due to misplacement and increases equipment utilization. By tracing these items, hospitals have eliminated thefts and improved patient flow. Although active technology can provide financial benefits, it is not always the most cost efficient option for low cost items. Passive technology would be a better option for access-controlled areas like labs or pharmacies. Doctors, nurses, and pharmacists can use RFID cards to access areas only personnel may be. Passive technology can also be used to determine whether surgical objects are left within a patient. This type of technology can also be used to track pharmaceutical assets and monitor the inventory to minimize inventory costs associated with expired medication.

Both passive and active technologies have a place in healthcare, but each has their own advantages and disadvantages. One must evaluate the operation to determine the most cost-effective application of the technology. To reap the greatest financial benefits, one must realize that neither technology is the best for all hospital operations. One obstacle to this marriage is the lack of consistencies of the standards for the two technologies. New debates may aid in overcoming this obstacle by looking at a battery assisted passive RFID platform. This standard would support both the existing EPCglobal Class 1 Gen 2 standard and the emerging ISO 18000-6C Class 3 Standard at a 915 MHz frequency. The new platform would provide leading battery assisted passive RFID performance and capabilities that are normally seen in active systems. This solution would allow customers better visibility at the right price. In contrast, the DASH7 Alliance supports the ISO 18000-7 standard which is working to make active technology less

expensive at 433 MHz frequency. With these two standards working towards converging, the future is bright. Hospitals must determine what frequency is best for their operations, and only time will tell which frequency will reign supreme. The future of hospitals lies in both technologies working together to improve patient safety and equipment utilization while reducing medical errors and costs associated with unused inventory misplaced equipment, or inefficient hospital operations.

Biographies

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Images:

Figure 1: Figure1.pdf

Caption: Barcodes in patient and drug identification.

Figure 2: Figure2.pdf

Caption: Schematic process flow in an automated hospital [5]