Literature Review: Mattress Tracking

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Bed Registry Systems

Bed registry systems offer several advantages. They significantly improve resource management by optimizing bed utilization and enhancing coordination among departments and facilities. By providing real-time data on bed availability, these systems help prevent overcrowding and ensure patients are placed in appropriate settings based on their needs, thereby increasing patient safety. Additionally, bed registry systems streamline operations by accelerating the admission and discharge processes and offering valuable data for operational planning. They also improve communication within healthcare settings by providing a centralized platform for bed status information.

However, there are also notable drawbacks to these systems. The initial implementation can be costly, including expenses for software, hardware, and staff training, with ongoing maintenance costs for updates and technical support. Data accuracy and reliability pose concerns, as errors in data entry or system malfunctions can affect decision-making. Privacy and security issues also arise, given the sensitive nature of patient information, which necessitates strict adherence to regulations like HIPAA. Finally, staff may face a learning curve and potential resistance to adopting new technology, which can temporarily disrupt facility operations and affect overall efficiency.

RFID

RFID, or Radio Frequency Identification, is a technology that uses radio waves to automatically identify and track objects. It consists of two main components: RFID tags and RFID readers.

- **RFID Tags:** These are small devices attached to objects that contain a microchip and an antenna. The microchip stores information, while the antenna enables the tag to receive and transmit radio signals. RFID tags can be passive (powered by the reader's signal), active (with a battery to transmit signals), or semi-passive (with a battery but relying on the reader to power the communication).

- **RFID Readers:** These devices emit radio waves to communicate with the RFID tags. They receive information from the tags and transmit it to a computer system for processing and analysis.

RFID technology is widely used in various applications, including inventory management, supply chain logistics, access control, and, notably, in healthcare for tracking medical equipment, patient identification, and bed management. The technology offers advantages such as automation, improved accuracy, and the ability to track items in real-time without requiring direct line-of-sight.

RFID bed tracking systems in healthcare provide a range of benefits and challenges. One of the primary advantages is their ability to enhance asset and resource management. By using RFID technology to tag and monitor beds, organizations can accurately track bed availability in real-time, which helps optimize bed utilization and streamline patient placement. This capability reduces the risk of overcrowding and ensures that patients are placed in suitable environments based on their needs, thereby improving overall patient safety. Additionally, RFID systems facilitate more efficient operations by speeding up the admission and discharge processes and providing valuable data for operational planning. The automation of bed tracking also improves communication among healthcare staff by centralizing bed status information on a single platform.

On the downside, implementing RFID bed tracking systems can be costly. The initial investment includes expenses for RFID tags, readers, and the necessary software, along with ongoing costs for system maintenance and technical support. Data accuracy is another concern, as system errors or tag malfunctions can lead to incorrect information and impact decision-making. Privacy and security issues also need to be addressed, as RFID systems handle sensitive patient information and must comply with regulations like HIPAA. Moreover, staff may experience a learning curve when adapting to new technology, and resistance to change could temporarily disrupt operations. Despite these challenges, the benefits of RFID bed tracking systems often outweigh the drawbacks, particularly in terms of efficiency and improved patient care.

Product Examples

1. Zebra Technologies: Zebra MC3390R RFID Reader & Zebra AN440 RFID Antenna
2. Honeywell: Honeywell HF RFID Tags & Intermec IF2 RFID Reader

Real-Time Location Systems

Infrared (IR) Real-Time Location Systems (RTLS) uses infrared sensors and tags to track objects. This system can be very accurate indoors but requires the installation of IR sensors throughout the facility. Ultrasound RTLS utilizes ultrasound signals to locate objects. This method is precise and effective in indoor environments but can be more costly. UWB (Ultra-Wideband) RTLS provides high accuracy and can work well in complex environments with many obstructions. It is particularly effective in tracking high-value assets like care beds and mattresses.

RTLS provides high accuracy and real-time tracking capabilities. Different technologies within RTLS, such as Ultra-Wideband (UWB) and Infrared (IR), offer precise location data, which is crucial for managing and locating facility assets like beds and mattresses. RTLS can also integrate with existing management systems to streamline operations and improve asset utilization. The accuracy of these systems helps minimize the time spent searching for equipment, thus enhancing overall efficiency.

RTLS can be expensive to implement, especially in large or complex care environments, due to the need for specialized infrastructure and equipment. Installation and maintenance can be labor-intensive, and some RTLS technologies, like UWB or IR, may require significant adjustments to the facility's layout or additional hardware. Additionally, the system's performance might be affected by obstacles or interference, depending on the technology used. There are also limitations on close range tracking.

Product Examples

1. Zebra UWB Tag Badge UWT-1200-A-00AA

2. Sonitor Sense
3. Securitas Healthcare

Bluetooth Low Energy

BLE beacons can be attached to mattresses or beds to provide location data. These beacons communicate with fixed BLE receivers placed throughout the facility to determine the location of the tagged items. BLE beacons are relatively cost-effective and easy to deploy, leveraging the existing Bluetooth infrastructure in many modern devices. They offer a good balance of accuracy and range for indoor tracking and are particularly useful in environments where frequent updates on asset locations are not critical. BLE beacons also require minimal infrastructure changes, making them a less disruptive option for care facilities.

While BLE beacons are effective for indoor tracking, their accuracy is generally lower compared to RTLS technologies like UWB. The range and signal strength can be affected by physical obstructions and interference from other Bluetooth devices. Additionally, BLE-based systems may not provide real-time tracking with the same precision as RTLS solutions, which could be a limitation in fast-paced care settings.

Product Examples

1. Estimote Proximity Beacons
2. Kontakt.io Beacons, Nano Tags or Sticker Tags
3. Gimbal Bluetooth Beacons

Wi-Fi-Based Tracking

Wi-Fi-based systems use existing facility Wi-Fi networks to track the location of assets. Tags are equipped with Wi-Fi transmitters, and their signals are picked up by access points to determine their location. Wi-Fi-based tracking systems can leverage existing Wi-Fi networks within a care facility, making them cost-effective in terms of infrastructure. They provide broad coverage and can be relatively easy to integrate into current systems, reducing the need for additional

hardware. This approach is beneficial in environments where the facility already has a robust Wi-Fi network in place.

The accuracy of Wi-Fi-based tracking can be less precise compared to RTLS and BLE solutions, particularly in environments with many obstructions or interference. Wi-Fi signals may not provide the granularity needed for precise asset tracking, which could lead to less reliable location data. Additionally, Wi-Fi-based systems might be more susceptible to network congestion, potentially impacting performance and reliability.

Product Examples

1. Centrak Wi-Fi RTLS
2. Versus Advantages
3. Ekahau RTLS

Other

Apple AirTag

Although AirTags are not designed for asset tracking, they do have the capability. They are cost-effective and easy to use, making them an affordable choice for basic tracking needs. They leverage the extensive Find My network, which can help locate items within areas with many Apple devices. Their compact size and lightweight design allow for easy attachment to various objects.

AirTags offer limited accuracy and are not designed for continuous, high-precision asset tracking. They depend on Bluetooth and the Find My network, which may not be reliable in large or complex environments. Additionally, AirTags lack integration with facility asset management systems and have privacy features that could complicate their use. Their battery life, while manageable, may require more frequent maintenance in a high-use setting.

Manual Bed Tracking Logs

Excel or Google Sheets are cost-effective solutions that can be utilized to track mattresses. It is a budget-friendly solution since most organizations already have access to Excel through standard office software suites. The platform allows for extensive customization, enabling users to tailor spreadsheets to their specific needs with custom columns, formulas, and data validation. Additionally, Excel is user-friendly and provides immediate availability, requiring minimal setup time compared to specialized systems. Its built-in data analysis tools, such as pivot tables and charts, also facilitate the review and analysis of bed usage patterns.

However, Excel has several limitations for bed tracking. Manual data entry is time-consuming and prone to errors, potentially leading to inaccurate information about bed availability and patient assignments. The lack of real-time updates and automation means that information can become outdated or incorrect if not frequently updated. Collaboration can be challenging, with simultaneous updates risking data conflicts and loss. Additionally, Excel may struggle with scalability issues as the volume of data grows and lacks integration with other management systems, potentially leading to inefficiencies and data silos. Security concerns also arise, as Excel spreadsheets can be vulnerable to unauthorized access and accidental modifications.

Cost Breakdown

1. Excel or Google Sheets – Free
2. Apple AirTag - $39 - $129 (raw cost – does not account for materials which may be required to attach to mattresses)
3. Bluetooth Low Energy:
    - Estimote Proximity Becons $199
    - Kontakt.io Smark Beacons $35 to $70
    - Gimbal $41 to $80
4. RFID Systems – Ranging from $700 to $7000 (for tags and readers)
5. Real-Time Location Systems – Ranging from $65,000 to $250,000