

# Software Requirements Specification (SRS) for Hospital Bed and Equipment Availability Tracker

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## 1. Introduction

### 1.1 Purpose

The purpose of this document is to define the software requirements for the **Hospital Bed and Equipment Availability Tracker**, a real-time system designed to monitor and manage the availability of hospital beds and medical equipment. The system will use AI to suggest optimal resource allocation based on patient needs and the current status of hospital resources.

### 1.2 Scope

This system will be a web-based application for hospital staff to monitor bed occupancy, track medical equipment, and provide real-time recommendations for resource allocation using AI. The system will:

- Display real-time availability of beds and equipment.
- Notify staff about resource shortages or excesses.
- Use AI to suggest the optimal allocation of beds and equipment based on patient needs and resource availability.
- Provide hospital management with historical data and trends for decision-making.

### 1.3 Definitions, Acronyms, and Abbreviations

- **AI**: Artificial Intelligence.
- **RAG**: Retrieval-Augmented Generation, used for real-time AI-based information retrieval and decision-making.
- **FastAPI**: A high-performance backend framework for building APIs.
- **PostgreSQL**: A relational database for storing data.
- **Hospital Resource**: Includes both beds and medical equipment (e.g., ventilators, oxygen tanks, etc.).

### 1.4 References

- Next.js documentation
- FastAPI documentation
- Langchain RAG documentation
- PostgreSQL official guide
- Medical resource management guidelines

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## 2. Overall Description

### 2.1 Product Perspective

The **Hospital Bed and Equipment Availability Tracker** is designed as an integral tool for hospital resource management. Using AI-driven recommendations, it ensures the efficient allocation of beds and medical equipment based on real-time hospital occupancy and patient needs.

## 2.2 Product Features

1. **Real-Time Resource Monitoring:** Display current availability of hospital beds and equipment.
2. **AI-Driven Allocation Recommendations:** Suggest optimal allocation of beds and equipment based on patient priority and hospital resource status.
3. **Alerts and Notifications:** Notify staff of critical shortages, resource unavailability, and system alerts.
4. **Patient Tracking:** Keep track of patient admissions and discharges to update bed occupancy in real-time.
5. **Reporting and Analytics:** Generate historical reports on resource usage, trends, and capacity projections.
6. **Equipment Status Updates:** Track medical equipment usage, location, and maintenance schedules.

## 2.3 User Characteristics

- **Hospital Staff:** Healthcare professionals responsible for managing hospital beds and equipment.
- **Admin:** Hospital management staff who oversee operations and use analytics for decision-making.

## 2.4 Constraints

- Must integrate with existing hospital infrastructure for patient and equipment data.
- Must handle high concurrency, as multiple users may access the system simultaneously during peak hours.

## 2.5 Assumptions and Dependencies

- The system assumes access to accurate, real-time data about beds and equipment from existing hospital databases or APIs.
- Dependencies include existing electronic health record (EHR) systems, inventory management systems, and hospital administrative databases.

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## 3. Specific Requirements

### 3.1 Functional Requirements

#### 3.1.1 Real-Time Resource Monitoring

- **FR1:** The system will display current availability of hospital beds and medical equipment in a dashboard view.
- **FR2:** Beds will be categorized by type (e.g., ICU beds, general beds) and equipment by functionality (e.g., ventilators, dialysis machines).

#### 3.1.2 Patient Tracking and Bed Occupancy

- **FR3:** The system will update bed occupancy when patients are admitted, transferred, or discharged.
- **FR4:** Staff can assign beds to patients through the interface, updating real-time occupancy status.

#### 3.1.3 Equipment Tracking

- **FR5:** Track the availability, location, and usage of critical medical equipment.
- **FR6:** Equipment status updates will include maintenance schedules and downtime for repairs.

### 3.1.4 AI-Driven Resource Allocation

- **FR7:** AI will analyze real-time data (e.g., patient severity, equipment usage, bed availability) to suggest optimal bed and equipment assignments.
- **FR8:** The AI will consider constraints such as proximity to patient care areas and equipment requirements based on patient conditions (e.g., ventilators for critical care patients).

### 3.1.5 Alerts and Notifications

- **FR9:** The system will send alerts for bed or equipment shortages, critical equipment malfunctions, or maintenance requirements.
- **FR10:** The system will alert staff when there are mismatches between patient needs and available resources.

### 3.1.6 Reporting and Analytics

- **FR11:** Generate reports on bed and equipment usage trends over time, including average occupancy rates and equipment downtime.
- **FR12:** Provide predictive analytics for hospital resource planning, including projected future resource demands based on historical data.

### 3.1.7 User Roles and Permissions

- **FR13:** Admin users can manage hospital-wide data and configure AI parameters for resource allocation.
- **FR14:** Hospital staff will have read and write access to data relevant to their department or floor, while admin users will have full access.

## 3.2 Non-Functional Requirements

### 3.2.1 Performance

- **NFR1:** The system must handle up to 500 concurrent users (hospital staff) without significant latency.
- **NFR2:** The system should update bed and equipment availability within 1 second of data input.

### 3.2.2 Scalability

- **NFR3:** The system must be able to scale to accommodate larger hospitals with more resources and staff.

### 3.2.3 Reliability

- **NFR4:** The system should have 99.9% uptime to ensure critical functionality is available at all times.

### 3.2.4 Security

- **NFR5:** The system must encrypt sensitive information (e.g., patient records, bed assignments) to comply with HIPAA and other healthcare regulations.
- **NFR6:** The system must include role-based access control to ensure only authorized personnel can access or modify sensitive data.

### 3.2.5 Usability

- **NFR7:** The system must have an intuitive, easy-to-navigate user interface designed for healthcare professionals with minimal technical training.

## 3.3 Database Requirements

### 3.3.1 PostgreSQL Integration

- **DR1:** PostgreSQL will store real-time data about bed and equipment availability, patient assignments, and historical data for reporting.
  - **DR2:** The database should support complex queries to retrieve relevant information quickly, ensuring the system responds in real-time.
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## 4. System Architecture

### 4.1 Web Interface (Next.js)

- The system's user interface will be built using **Next.js**, allowing hospital staff to access the dashboard, update data, and view reports from any web browser.

### 4.2 Backend (FastAPI)

- **FastAPI** will handle backend logic for managing bed and equipment data, user authentication, and integrating with external systems like EHR databases.

### 4.3 AI Engine (Langchain RAG)

- **Langchain RAG** will be used to power the AI component, providing real-time recommendations for resource allocation based on current availability and patient needs.

### 4.4 Database (PostgreSQL)

- **PostgreSQL** will store and manage data on beds, equipment, patients, and historical analytics.
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## 5. System Interfaces

### 5.1 API Interfaces

- **EHR API:** Connect to the hospital's Electronic Health Record system to retrieve patient data and update resource allocation based on patient condition.
- **Equipment Management API:** Integrate with the hospital's existing equipment tracking systems to monitor equipment usage and maintenance.

### 5.2 User Interfaces

- **Hospital Staff UI:** Web-based dashboard to view and update bed occupancy, equipment availability, and patient data.

- **Admin Dashboard:** Interface for hospital management to access historical reports, configure AI allocation parameters, and manage hospital-wide data.

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## 6. Data Flow Diagram

1. **Patient Admission** → **Hospital Staff (Next.js UI)**
2. **Next.js UI** → **FastAPI Backend** → **Update Bed/Equipment Status**
3. **FastAPI Backend** → **PostgreSQL (Store Data)**
4. **FastAPI Backend** → **Langchain RAG (AI Resource Allocation)**
5. **Langchain RAG** → **Next.js UI (Recommendations Display)**
6. **Real-Time Monitoring and Alerts**

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## 7. Testing Requirements

### 7.1 Functional Testing

- Validate real-time bed and equipment availability updates.
- Test the AI-driven resource allocation algorithm with various patient scenarios.
- Ensure that alerts and notifications trigger correctly for resource shortages.

### 7.2 Performance Testing

- Load test the system to ensure it can handle multiple concurrent users.
- Measure real-time update response times for bed and equipment changes.

### 7.3 Security Testing

- Conduct security audits to ensure compliance with healthcare data protection standards.
- Test role-based access control and verify that sensitive data is only accessible to authorized users.

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## 8. Future Enhancements

1. **Integration with Wearable Devices:** Monitor patient vitals and adjust bed/equipment recommendations in real-time based on patient health metrics.
2. **Mobile App for Hospital Staff:** Extend the system to mobile devices, allowing staff to update bed and equipment status on the go.
3. **Inter-Hospital Resource Sharing:** Implement a network for hospitals to share resources (e.g., equipment, ICU beds) in case of shortages.

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This SRS outlines the functional and non

-functional requirements of the **Hospital Bed and Equipment Availability Tracker**. The system aims to improve hospital efficiency, enhance patient care, and optimize the use of critical resources with the help of AI-powered recommendations.