

HCI Assignment 1: Smart Hospital Dashboard

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GitHub: github.com/HarshalPatel1972/HCI-Assignment-1

Live UI: smart-hospital-eight.vercel.app

1. Dashboard Design & Implementation (Dashboard)

This project features a fully functional, highly responsive, and interactive **Smart Hospital Dashboard** developed using modern web technologies (React via Vite and Tailwind CSS). The dashboard successfully fulfills the core requirements by simultaneously tracking four critical vitals: Heart Rate (HR), Blood Oxygen (SpO2), Non-Invasive Blood Pressure (NIBP), and Temperature across multiple patients.

Responsive Multi-device Views

The User Interface seamlessly scales across standard hardware typical in a hospital environment:

- 1. Desktop/Large Display:** Displays a high-density grid showing all patient metrics on a single screen without needing navigation, perfect for central nursing stations.
- 2. Tablet View:** Restructures for touch navigation with appropriately sized hit targets mapping clinical workflows.
- 3. Wearable/Mobile View:** Condenses perfectly into a vertical flex layout prioritizing immediate critical alerts and single-patient deep dives without any horizontal scrolling.



Figure 1: Desktop / Large Display grid layout simulating real-time monitoring.

2. Evaluation of Human Factors (HCI I/O, Memory, Reasoning)

Human I/O Channels

The dashboard is designed to heavily utilize human sensory channels to drastically reduce the margin of cognitive error:

- **Visual Filtering:** The interface leverages a clinical dark background (`bg-slate-900`) with high-contrast, color-coded medical badges. Green indicates stability, yellow indicates warning traits, and red signifies a critical threshold break.
- **Pre-attentive Processing:** Critical metrics feature a pulsing visual anomaly (e.g., a scaling heartbeat animation via Tailwind's `animate-pulse` and `animate-ping`). This draws the clinician's peripheral vision immediately, addressing visually over-stimulated environments.
- **Auditory & Haptic Potential:** The top sticky alert banners imply a direct hardware trigger for auditory alarms on nursing stations or haptic vibrations on doctor wearables.

Memory Optimization

The interface mitigates heavy reliance on short-term working memory by comprehensively applying the heuristic of **Recognition over Recall**:

- Industry-standard Iconography (Lungs for SpO2, Heart for HR, Droplet for NIBP) immediately registers the metric without needing to read textual labels.
- Information is persistently grouped. A doctor does not have to remember a patient's room number; the ID, Age, and Room act as a persistent header for every vitals box to eliminate cognitive load.

Reasoning and Problem Solving

Rapid decision-making under intense pressure is supported via contextual bounds. Vitals numbers visually change color the precise moment they cross mathematically safe thresholds (e.g., HR > 130 bpm turns red). This handles the "pattern recognition" workload computationally, allowing doctors to skip the interpretation phase and jump directly to the reasoning/triage phase. Furthermore, by grouping associated metrics intrinsically (e.g. visualizing NIBP directly adjacent to SpO2), clinicians can rapidly deduce whether a patient is hypotensive and hypoxic simultaneously, forming a complete clinical picture in seconds rather than cross-referencing multiple charts.

Dashboard

Patients

Alerts

1

Settings

一心 1 Patient(s) require immediate attention!

Meera Desai

● ICU-A1

68 yrs • ID: #20205

HR



70

bpm

SPO2



98

%

NIBP



115/78

TEMP



37.1

°C

Rahul Sharma

● ICU-A2

45 yrs • ID: #20206

HR



120

bpm

SPO2



96

%

NIBP



147/88

TEMP



38.5

Patient Monitoring Overview

Priya Patel

● ICU-A3

34 yrs • ID: #20207

HR



65

bpm

SPO2



99

%

NIBP



108/77

TEMP



36.8

°C

Anil Kumar

● ICU-B1

82 yrs • ID: #20208

HR



133

bpm

SPO2



90

%

NIBP



81/56

TEMP



35.9

Patient Monitoring Overview

Sunita Reddy

● ICU-B2

56 yrs • ID: #20209

HR



78

bpm

SPO2



94

%

NIBP



125/83

TEMP



37.3

°C

Vikram Singh

● ICU-B3

71 yrs • ID: #20210

HR



97

bpm

SPO2



92

%

NIBP



138/84

TEMP



37.9

Patient Monitoring Overview

Connected

Simulate Offline

Figure 2: Responsive Tablet View, demonstrating clustered information.

3. Analysis of Computer-Related Factors

Device Suitability

Different clinical interfaces are required for diverse physical constraints. The React application uses robust Tailwind CSS Grid algorithms to modify data density automatically:

- **Central Displays** stream multi-patient data asynchronously, suitable for high-bandwidth processing capabilities.
- **Tablets and Wearables** reorganize into single-column feeds, respecting smaller screen constraints and prioritizing immediate actionable alerts over general ward surveillance.

Processing Speed and Memory Load

In an ICU context, blocking the main UI thread can critically delay life-saving alerts. To combat this:

- The dashboard utilizes React's Virtual DOM optimized rendering rather than forcing standard browser repaints.
- This drastically cuts down local client memory load, ensuring the system can process frequent, high-velocity JSON/WebSocket payloads from hospital infrastructure without browser lag or hanging.

Network Reliability Simulation

Hospitals frequently suffer from spotty Wi-Fi networks in structurally dense zones (e.g., Radiology or Basement Wards).

- **The "Simulate Offline" Feature:** The dashboard includes an overt offline simulation toggle. When the network drops, the UI explicitly grays out (opacity drops and grayscale filters are applied) and explicitly warns that the data is "Frozen".
- This fulfills a critical software medical safety constraint: a clinician must ^{never}

make critical decisions assuming vitals are real-time when the connection has actually stalled. The system safely handles asynchronous data loss without crashing the main application state.

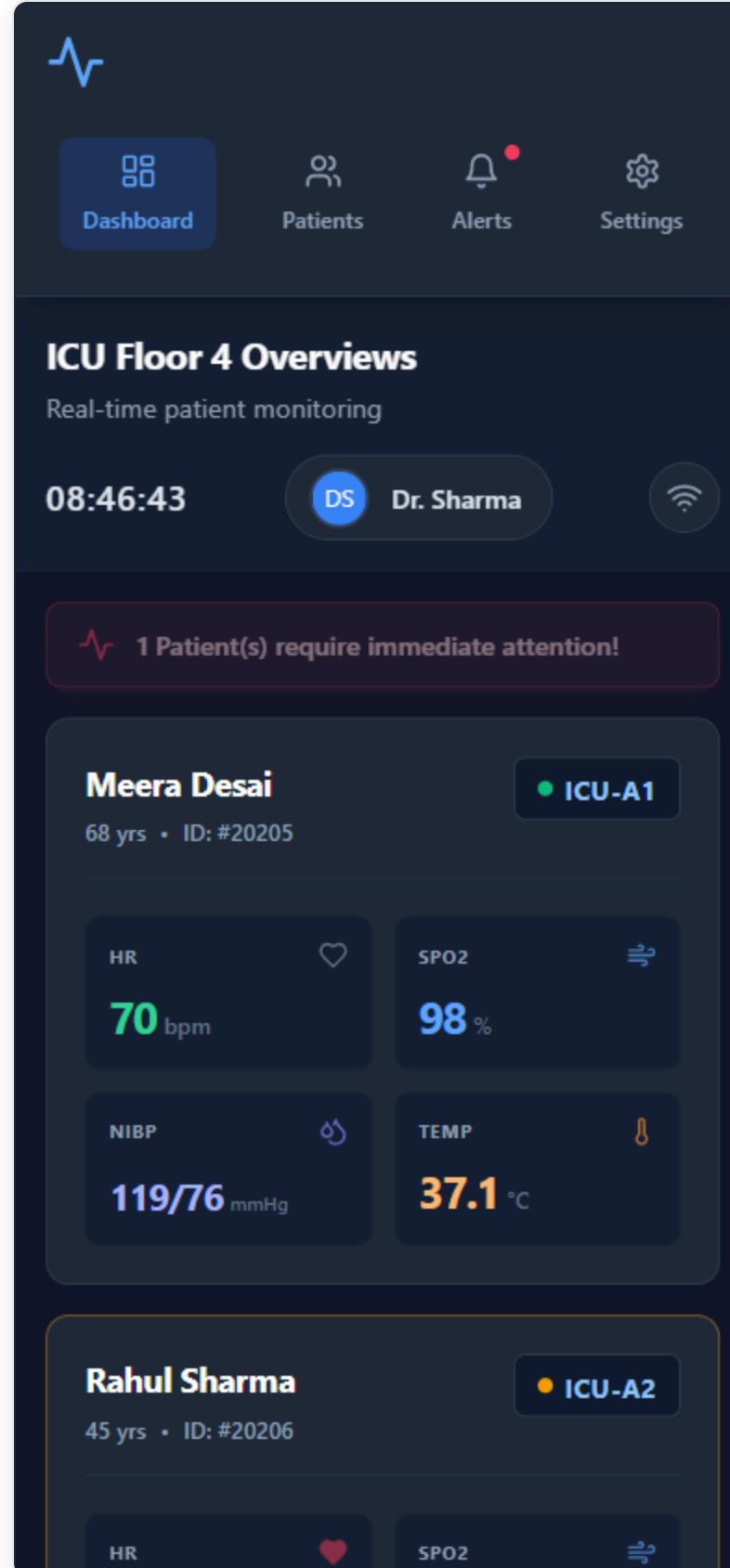


Figure 3: Wearable/Mobile constraints with visible "System Offline" safety state active.

4. Enhancement of Usability

To finalize the UI, several enhancements were driven by established HCI models and ergonomic principles to ensure an exemplary user experience:

HCI Models Applied

- **GOMS Model (Goals, Operators, Methods, Selection Rules):** The primary goal of a clinician approaching a screen is usually "Find who needs help." By adding a top sticky "Alert Banner" spanning the width of the display, the Method

length to identify a critical patient drops to a single visual operation, bypassing the need to linearly scan 20+ individual grid cards.

Ergonomic Principles

- **Visual Ergonomics:** Constant glaring white screens cause severe eye fatigue for night-shift clinicians. Our use of Deep Space Dark themes (`bg-slate-900` surface colors) heavily reduces blue-light eye strain over a 12-hour shift.
 - **Fitts's Law:** Interactive elements (like the sidebar navigation items and the network toggle) feature generous padding, increasing the physical target area. This makes rapid touch interactions on tablets and mobile phones reliably faster and significantly less prone to mis-clicks during localized emergencies.
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