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Healthcare Transaction Authorization and Management Computer Device

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Abstract:
This technical report presents the design, functional concept, and technological significance of a registered industrial invention titled "Healthcare Transaction Authorization and Management Computer Device," formally protected under UK Design Registration No. 6496417 and granted by the United Kingdom Intellectual Property Office on 29 January 2026
The invention is classified within International Design Classification Class 14, covering recording, telecommunication, and data-processing equipment, reflecting its role as an integrated digital platform for secure healthcare transaction processing and operational management.
The invention introduces a purpose-built computing device engineered to support real-time authorization, monitoring, and management of healthcare transactions within clinical and administrative environments. The device integrates multiple interaction interfaces, including a primary visual display, auxiliary control modules, structured input mechanisms, and communication components arranged within a compact and ergonomically optimized hardware architecture. The design representations demonstrate a unified system capable of supporting authentication workflows, transaction validation, data visualization, and operator interaction through an intuitive physical layout.
The primary objective of the invention is to address persistent challenges in healthcare transaction systems, including fragmented authorization processes, inefficient workflow coordination, and vulnerabilities associated with conventional computing terminals used in medical environments. By consolidating transaction authorization, device interaction, and data management into a dedicated platform, the invention enhances operational efficiency, reduces processing delays, and strengthens system reliability in healthcare settings where accuracy and timeliness are critical.
From a technical perspective, the device emphasizes human-machine interaction efficiency, modular hardware organization, and secure processing capability. The configuration supports deployment in hospitals, pharmacies, diagnostic centers, insurance authorization points, and other healthcare service environments requiring controlled access to sensitive medical and financial data. The structural design also allows adaptability for future integration with digital health infrastructure, including electronic health records (EHR), telemedicine platforms, and secure payment authorization systems.

The registered design represents a convergence of healthcare informatics, secure transaction processing, and specialized computing hardware engineering. Its novelty lies not only in the aesthetic configuration but also in the functional arrangement of components tailored specifically to healthcare operational workflows. The invention therefore contributes to advancing digital healthcare infrastructure by providing a dedicated, secure, and ergonomically optimized authorization and management terminal.
This report documents the technical rationale, design architecture, operational framework, and potential implementation contexts of the invention, establishing a foundation for engineering evaluation, commercialization planning, and future system development.

1. Introduction: Scope and Field of the Study

The present design relates to the field of healthcare information technology systems, specifically within the domain of specialized computing devices developed for transaction authorization, data processing, and operational management in medical environments. The invention falls under the broader technological area of digital healthcare infrastructure, where dedicated hardware platforms are engineered to support secure handling of clinical, administrative, and financial transactions. As indicated in the registered classification, the device belongs to recording, telecommunication, and data-processing equipment designed for professional operational use
More particularly, the design concerns healthcare transaction authorization systems, which facilitate controlled access, verification, and validation of healthcare-related activities such as patient registration, treatment authorization, billing confirmation, insurance verification, and service documentation. Unlike conventional general-purpose computers, the device is purpose-built to integrate transaction management functions with structured user interaction interfaces, enabling healthcare personnel to perform secure operations within time-sensitive clinical workflows.
The field further encompasses human–machine interface (HMI) engineering for healthcare applications, where ergonomic configuration, accessibility, and operational clarity are essential design considerations. The visual representations of the device demonstrate an integrated arrangement of display modules, input controls, and communication components intended to optimize user interaction while minimizing operational complexity in high-demand healthcare settings. Such systems are particularly relevant in environments requiring rapid decision-making and accurate data entry, including hospitals, pharmacies, diagnostic laboratories, and medical service authorization centers.
In addition, the design operates within the expanding discipline of secure digital transaction management and medical data processing, addressing growing demands for reliable authentication and controlled information exchange. Modern healthcare systems increasingly rely on interconnected digital platforms, creating the need for dedicated terminals capable of supporting secure authorization procedures while maintaining workflow efficiency. The invention contributes to this field by providing a consolidated hardware platform tailored to healthcare operational requirements rather than adapting generic computing equipment.
Finally, the design aligns with emerging developments in integrated healthcare technology ecosystems, including electronic health record systems, telemedicine platforms, and digitally enabled insurance processing infrastructures. By combining transaction authorization capabilities with specialized hardware architecture, the device supports the ongoing transformation toward automated, secure, and interoperable healthcare service delivery. The field of the design therefore lies at the intersection of healthcare informatics, secure computing systems, and specialized medical operational technology.

1.1 Background and Research Motivation

The rapid digital transformation of healthcare systems worldwide has led to an increasing reliance on electronic platforms for managing clinical services, patient information, billing operations, and authorization processes. Healthcare providers now operate within highly interconnected environments where transactions involving medical services, insurance approvals, and data validation must be completed accurately and in real time. Traditional computing systems used in healthcare facilities were primarily designed as general-purpose workstations and were not optimized for the specialized operational, security, and workflow requirements of healthcare transaction management. This gap has created inefficiencies, operational delays, and increased exposure to data handling errors.

Conventional healthcare transaction processes often involve multiple disconnected devices and software interfaces, requiring healthcare personnel to navigate complex systems for authorization, verification, and documentation tasks. These fragmented workflows can slow clinical operations, particularly in high-volume environments such as hospitals, pharmacies, and diagnostic centers. In addition, existing terminals frequently lack dedicated hardware configurations that support streamlined interaction, secure authentication, and structured transaction execution, resulting in reliance on improvised setups that do not adequately address healthcare-specific operational demands.

Another significant challenge arises from the growing need for enhanced data security and controlled access within healthcare environments. Healthcare transactions commonly involve sensitive personal and financial information, requiring strict authorization mechanisms and reliable processing platforms. General computing devices, while functional, are often not purpose-built to enforce structured transaction workflows or to provide ergonomic interfaces tailored to continuous professional use. As healthcare digitization expands, the limitations of conventional devices have highlighted the need for specialized hardware solutions capable of integrating authorization, monitoring, and management functions within a single system.

Advancements in healthcare informatics, telecommunication technologies, and digital payment infrastructures have further intensified the demand for dedicated transaction authorization devices. Healthcare institutions increasingly require systems that can support electronic health records, insurance verification, and real-time service authorization while maintaining operational efficiency and user accessibility. The absence of integrated hardware platforms specifically designed for these combined functions has created an opportunity for innovation in device architecture and interface design.

The present design was therefore developed to address these technological and operational shortcomings by introducing a purpose-built healthcare transaction authorization and management computer device. Registered under UK Design No. 6496417 the invention provides a unified hardware configuration intended to enhance workflow efficiency, improve user interaction, and support secure healthcare transaction processing. The design represents an evolution from generalized computing equipment toward specialized healthcare operational terminals capable of meeting modern digital healthcare requirements.

2. Related Technologies and Review of Prior Art

In the domain of healthcare transaction authorization systems, medical data-processing terminals, secure payment validation platforms, and healthcare information management devices, numerous prior inventions disclose computing systems designed for patient identification, electronic medical record processing, authentication workflows, and healthcare financial transactions. These prior systems typically emphasize software architectures, communication protocols, or distributed computing environments. Each

of these prior inventions, however, differs in key respects from the present registered design (Healthcare Transaction Authorization and Management Computer Device), which is protected as a registered industrial design emphasizing a unified physical workstation configuration integrating display interfaces, transaction controls, and processing components within a single compact enclosure

The following provides a comparative background of relevant prior art:

1. US20140114625A1 (Healthcare Payment Processing System)

US20140114625A1 discloses a healthcare payment processing system enabling electronic authorization and settlement of medical service payments through networked financial platforms. The invention focuses primarily on backend transaction workflows and payment authorization logic executed through software systems. In contrast, the present registered design emphasizes the industrial configuration of a dedicated physical device, integrating transaction interfaces, display modules, and operator controls into a unified healthcare workstation rather than a purely software-based payment framework.

2. US20190340463A1 (Medical Data Authentication System)

US20190340463A1 describes a system for authenticating medical data using encrypted communication between healthcare providers and remote databases. The innovation lies in cybersecurity mechanisms and authentication algorithms. Unlike this prior art, which centers on communication protocols, the registered design protects the physical arrangement and ergonomic integration of hardware elements supporting transaction authorization within a single device structure.

3. US20170236114A1 (Point-of-Care Medical Information Terminal)

This invention discloses a point-of-care terminal enabling clinicians to access patient information and input treatment data at bedside locations. The prior art emphasizes portable computing functionality and data retrieval capabilities. In contrast, the present design introduces a specialized authorization and management workstation, featuring structured transaction input areas and consolidated control architecture specifically tailored to authorization workflows rather than general clinical data viewing.

4. US20160092478A1 (Healthcare Identity Verification System)

US20160092478A1 focuses on biometric identity verification for healthcare access control using fingerprint or facial recognition systems. Its novelty resides in identity authentication technologies. The registered design differs by concentrating on integrated hardware configuration, combining multiple interaction interfaces within a single enclosure rather than emphasizing biometric authentication techniques alone.

5. US20180211233A1 (Electronic Medical Record Access Device)

US20180211233A1 discloses a computing device allowing secure access to electronic medical records through remote servers. The invention is largely software-driven and relies on conventional computing hardware. By comparison, the present registered design protects a distinct workstation-style physical architecture purpose-built for healthcare transaction authorization and operational management rather than adapting generic computer terminals.

6. US20190147459A1 (Healthcare Service Authorization Platform)

This patent application describes a system for authorizing healthcare services through centralized digital approval workflows between insurers and providers. The invention primarily addresses communication processes and approval logic. In contrast, the registered design provides a self-contained physical authorization terminal, emphasizing ergonomic layout, unified interface placement, and integrated hardware interaction.

7. US20150332242A1 (Medical Billing and Claims Processing System)

US20150332242A1 presents an automated medical billing and claims processing system designed to streamline insurance reimbursement procedures. Its contribution lies in workflow automation and billing analytics. Unlike this prior art, which focuses on administrative software, the present design protects the external product configuration and integrated physical interface supporting real-time authorization at operational points.

8. US20140278406A1 (Secure Healthcare Transaction Terminal)

US20140278406A1 discloses a secure transaction terminal enabling encrypted healthcare payments and patient account management. Although it introduces transaction hardware, it does not disclose the multi-interface consolidated workstation layout seen in the registered design, where display, controls, and communication components are structurally unified into a distinctive industrial form.

9. US20170083962A1 (Clinical Workflow Management Device)

This invention relates to systems that coordinate clinical workflows using distributed computing devices connected to hospital networks. The novelty lies in workflow coordination software rather than device configuration. The present registered design differs by emphasizing physical integration and ergonomic arrangement, enabling structured interaction through a single cohesive hardware unit.

10. US20160110545A1 (Healthcare Data Processing and Authorization System)

US20160110545A1 discloses a system for processing healthcare transactions using cloud-based authorization engines. The invention focuses on backend computation and remote processing infrastructures. In contrast, the registered design protects a localized, operator-facing hardware platform engineered to centralize interaction, visualization, and transaction control within one physical enclosure.

Summary of Differences

The reviewed prior inventions collectively advance healthcare technology through improvements in electronic payments, identity verification, data authentication, workflow automation, and cloud-based authorization systems. Most prior disclosures emphasize software methodologies, communication architectures, or distributed digital infrastructures rather than the industrial configuration of a specific physical device.

None of the referenced prior art is directed toward a compact, workstation-style healthcare transaction authorization device integrating multiple display regions, structured input controls, and operational interfaces within a single unified housing. The uploaded registered design uniquely consolidates visualization, transaction processing interaction, and management functionality into one coherent physical form, distinguishing it from systems dependent on general-purpose computers or modular peripherals.

A further distinction lies in the ergonomic and operational integration embodied in the registered design. While prior systems typically rely on standard computing terminals combined with external accessories, the present invention establishes a purpose-built healthcare authorization workstation designed for repeated operational deployment in clinical and administrative environments. This consolidation improves usability, deployment stability, and workflow efficiency.

Additionally, the registered design is formally protected as an industrial design under International Design Classification Class 14/02, reflecting protection of its physical configuration rather than software functionality alone

Prior inventions largely protect methods or systems, whereas the present design secures the identifiable external architecture and integrated device form.

Ultimately, the present design differentiates itself by formalizing a unified hardware architecture specifically tailored to healthcare transaction authorization and management. Rather than focusing solely on digital processes, it establishes a manufacturable and recognizable product configuration that merges healthcare computing functionality with ergonomic industrial design in a single integrated device.

3. Research Design and System Specification

The registered design relates to a Healthcare Transaction Authorization and Management Computer Device, protected under United Kingdom Design Registration No. 6496417 and classified within International Design Classification Class 14, covering recording, telecommunication, and data-processing equipment

. The design concerns the external configuration, structural arrangement, and visual appearance of a specialized computing device intended for use in healthcare environments requiring secure transaction authorization, operational control, and data management functions.

The registered design is characterized by a unified workstation-style enclosure incorporating an integrated display interface, structured user interaction region, and consolidated control components within a single compact device body. The overall configuration presents a cohesive physical architecture in which visualization, input interaction, and operational management features are spatially organized to support efficient user engagement. The design representations illustrate multiple perspectives of the device, demonstrating its balanced proportions, interface positioning, and ergonomic layout intended to facilitate continuous professional use.

A defining aspect of the registered design lies in the integration of functional interface elements into a singular physical structure rather than reliance on separate computing peripherals. The device embodies a coordinated arrangement of visual display surfaces, input mechanisms, and communication interfaces configured to enable healthcare personnel to perform authorization and management tasks through a centralized operational platform. The physical form emphasizes accessibility, stability, and clarity of interaction while maintaining a compact footprint suitable for clinical and administrative deployment.

The scope of protection afforded by the registered design resides primarily in the visual and industrial design features of the device, including its shape, configuration, relative arrangement of components, and overall aesthetic appearance as shown in the registered representations. Protection does not extend to underlying software algorithms, electronic circuitry, or operational methods except insofar as such elements contribute to the observable external form of the device.

Accordingly, the registered design establishes a distinctive and recognizable product configuration representing an integrated healthcare transaction terminal. The design reflects a convergence of healthcare informatics requirements and industrial product engineering, providing a dedicated physical platform optimized for authorization workflows, secure interaction, and structured data-processing operations within modern healthcare systems.

4. Technical System Architecture and Design Methodology

4.1 Overall Device Architecture and Structural Configuration

The Healthcare Transaction Authorization and Management Computer Device is designed as a self-contained workstation-style computing platform that integrates transaction authorization, data visualization, and user interaction capabilities within a single unified enclosure. The overall architecture reflects a purpose-built configuration intended for healthcare operational environments where reliability, accessibility, and controlled interaction are essential. Unlike conventional computing arrangements that depend on separate monitors, keyboards, and external peripherals, the registered design consolidates all primary operational components into one cohesive physical structure, thereby improving deployment efficiency and operational stability

The enclosure geometry adopts a compact, vertically oriented workstation form, combining a stable base structure with an elevated display section and an integrated interaction region. The structural layout is organized to maintain balance between visibility and accessibility: the upper section accommodates the visualization interface, while the lower section incorporates interaction controls and operational interfaces. This geometric arrangement enables users to simultaneously view transaction information and execute authorization actions without shifting position or relying on auxiliary devices. The device proportions are configured to support countertop or desk deployment within healthcare administrative or clinical service points.

A key architectural principle underlying the design is functional consolidation through integrated component placement. Core subsystems, including the display interface, processing unit, input controls, and communication interfaces, are structurally embedded within a single housing. This integration minimizes cable dependency, reduces installation complexity, and enhances device robustness in environments characterized by continuous use. The unified configuration also contributes to improved security by limiting exposure of critical interfaces and reducing opportunities for unauthorized hardware modification.

The spatial organization of functional elements follows a hierarchical interaction model. Visual information delivery occupies the upper visual zone, ensuring clear line-of-sight access for operators. Transaction input and authorization controls are positioned within the primary interaction zone, optimized for direct reach and intuitive operation. Internal processing and communication modules are enclosed within protected internal compartments, maintaining separation between user-facing interfaces and internal electronic subsystems. This layered arrangement supports efficient workflow progression from information review to authorization execution.

Structurally, the device emphasizes stability and permanence consistent with fixed healthcare workstation deployment. The enclosure integrates support surfaces and mounting alignment that allow secure placement while maintaining accessibility from the operator’s position. The integrated architecture ensures that all functional components operate as a coordinated system rather than independent accessories, reinforcing the design objective of delivering a dedicated healthcare transaction terminal with a recognizable and manufacturable physical identity.

Figure 1: Conceptual block diagram illustrating the integrated architecture of the Healthcare Transaction Authorization and Management Computer Device, showing consolidation of visualization, processing, interaction, and communication subsystems within a unified housing.

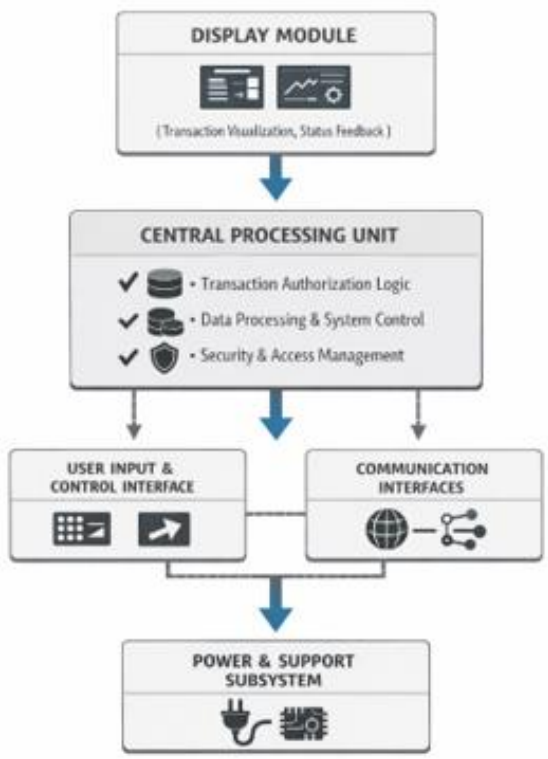
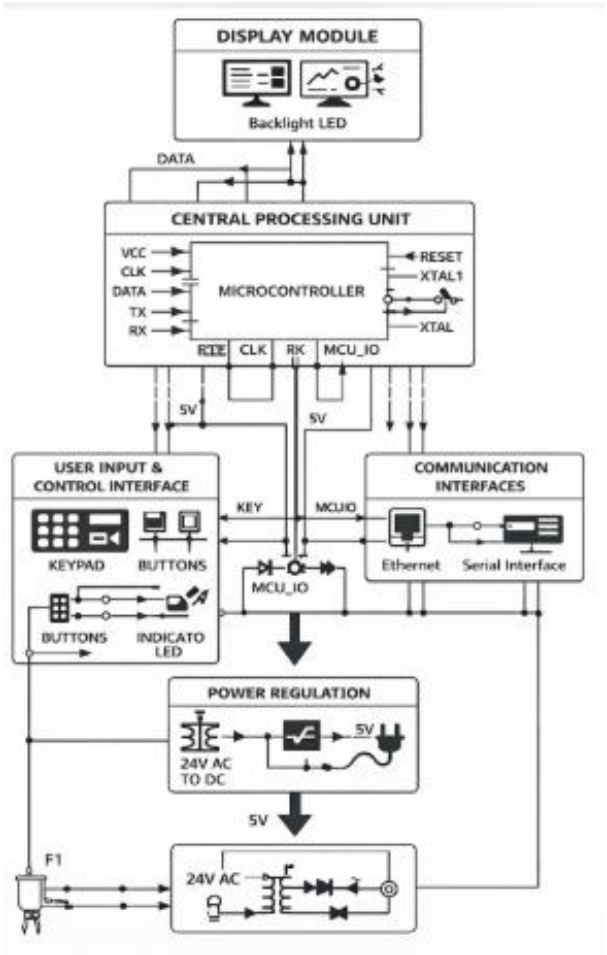


Figure 1: Block Diagram: Overall Device Architecture

Figure 2 presents a structured architectural overview of a microcontroller-based embedded system illustrating the interaction between functional subsystems responsible for processing, user interaction, communication, display control, and power management. At the core lies the Central Processing Unit (CPU), implemented through a microcontroller that coordinates data flow, clock synchronization, reset control, and input/output operations. The display module interfaces directly with the processor to provide visual feedback using a backlit LED screen driven by data signals. User input is handled through a dedicated control interface comprising a keypad, push buttons, and indicator LEDs, enabling command entry and operational status signaling. Communication interfaces, including Ethernet and serial connectivity, allow external data exchange and system integration with networked environments. Supporting all modules is a regulated power subsystem that converts a 24V AC supply into stable 5V DC output, ensuring safe and reliable operation across components. Signal paths and power lines are clearly delineated, demonstrating both logical data communication and electrical power distribution within a cohesive embedded hardware framework.



4.2 Display and Visualization Interface System

The display and visualization interface system forms the primary information delivery component of the Healthcare Transaction Authorization and Management Computer Device, serving as the central medium through which healthcare personnel interact with transaction data, authorization workflows, and operational system feedback. The integrated display unit is structurally embedded within the upper section of the unified enclosure, allowing it to function as the principal visual communication interface between the device and the operator. This placement ensures uninterrupted visibility during transaction processing while maintaining alignment with the ergonomic posture of users operating in seated or standing positions

Integrated Display Configuration

The display module is designed as a fixed, forward-facing visualization surface integrated directly into the device housing rather than mounted as an external monitor. This configuration enhances structural stability and reduces dependency on adjustable peripherals. The screen operates as a multifunction interface responsible for presenting patient transaction records, authorization confirmation prompts, workflow navigation menus, and real-time system status indicators. By consolidating visualization into a single embedded unit, the design minimizes operator distraction and supports sequential task execution.

The display system performs three primary visualization functions:

1. **T**ransaction Visualization presentation of healthcare service details, authorization status, and transaction summaries.

2. Decision Support Prompts display of approval requests, validation alerts, and verification instructions.
3. Operational Feedback system notifications, connectivity status, and processing confirmations.

Screen Positioning and Viewing Geometry

The display is positioned at an elevation and orientation intended to optimize operator viewing comfort and minimize neck strain during extended usage. The viewing configuration follows ergonomic display alignment principles, where the screen center is located near the user's natural eye level.

The effective viewing angle θ_v between the user's eye and the display surface may be approximated as:

$$\theta_v = \tan^{-1}\left(\frac{h_d - h_e}{d}\right) \tag{1}$$

where:

h_d = vertical height of display center

h_e = operator eye height

d = horizontal viewing distance

Optimal ergonomic performance is typically achieved when:

$$10^\circ \leq \theta_v \leq 20^\circ \tag{2}$$

This range reduces visual fatigue while maintaining clear readability of transaction information.

Visibility Optimization and Luminance Control

Healthcare environments exhibit varying illumination conditions, including fluorescent clinical lighting and daylight exposure. The display system is therefore designed to maintain visibility through brightness and contrast optimization. Screen luminance performance can be expressed as:

$$L = \frac{\Phi}{A \cdot \Omega} \tag{3}$$

where:

L = luminance (cd/m²)

Φ = luminous flux emitted

A = display area

Ω = solid viewing angle

Adequate luminance ensures readability of sensitive information such as authorization codes and transaction confirmations under diverse lighting conditions.

Contrast ratio C_r, essential for distinguishing interface elements, is defined as:

$$C_r = \frac{L_{max}}{L_{min}} \tag{4}$$

where L_{max} and L_{min} represent maximum and minimum luminance levels respectively. Higher contrast ratios improve rapid interpretation of alerts and reduce operator error during time-critical authorization processes.

Information Presentation Architecture

The visualization interface follows a layered information hierarchy structured to support healthcare workflows:

- **Primary Layer:** transaction identifiers and authorization status
- **Secondary Layer:** patient or service information
- **Tertiary Layer:** system notifications and operational indicators

This hierarchical arrangement reduces cognitive load by ensuring that the most critical information remains visually dominant. Visual segmentation enables operators to quickly identify required actions without navigating multiple interfaces.

Operational Feedback Mechanism

The display continuously communicates system state through visual feedback loops. Processing states may be modeled as discrete operational conditions:

$$S(t) \in \{Idle, Input, Verification, Authorized, Error\} \quad (5)$$

where $S(t)$ represents system state at time t. Transition between states is visually reflected through icons, color coding, or confirmation messages, enabling users to monitor transaction progression in real time.

Figure 6.2: Display Interface Functional Layout

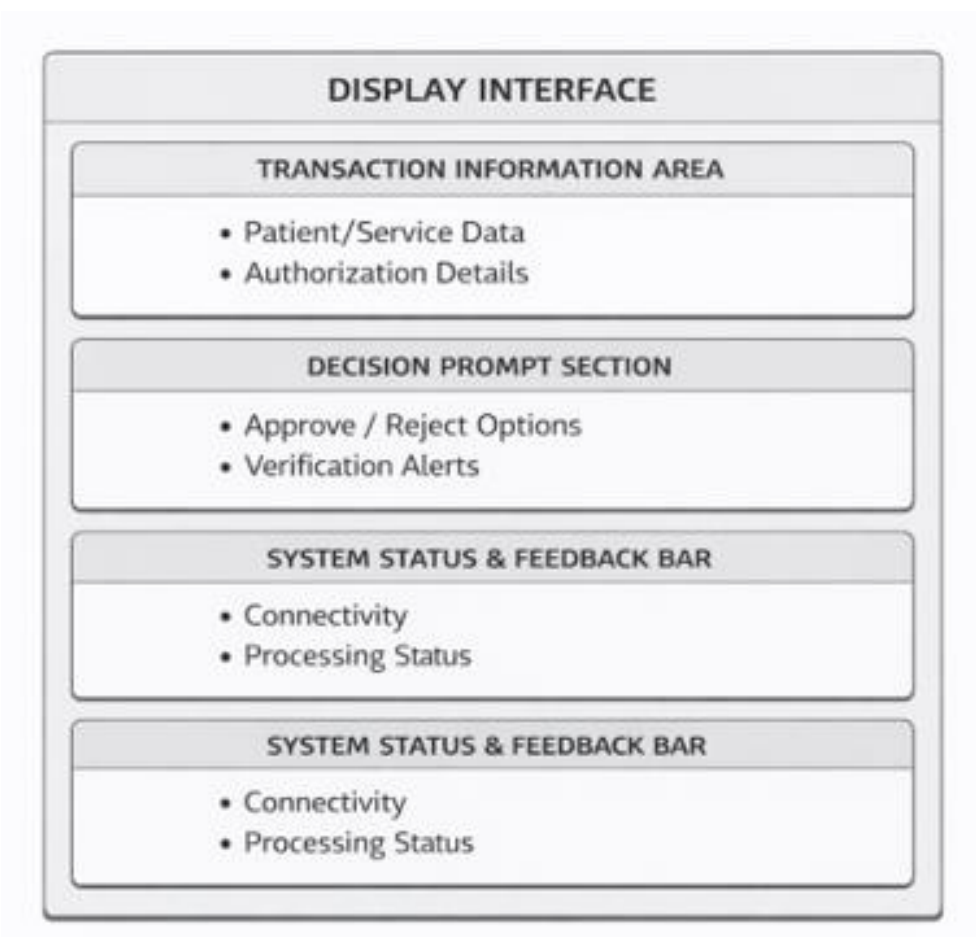


Figure 6.2: Conceptual layout of the integrated display and visualization interface showing hierarchical presentation of transaction data, authorization prompts, and operational feedback within the healthcare transaction device.

In summary, the display and visualization interface system is engineered to function as the cognitive interaction center of the device, combining ergonomic positioning, optimized visibility, and structured information presentation. Its integrated configuration supports accurate decision-making, reduces operational delays, and enhances usability within healthcare environments where transaction accuracy and clarity are essential.

4.3 User Interaction and Input Control Mechanisms

The user interaction and input control mechanisms constitute the operational interface through which healthcare personnel perform transaction entry, authorization commands, and workflow navigation within the Healthcare Transaction Authorization and Management Computer Device. The interaction subsystem is physically integrated into the lower interaction region of the unified enclosure, forming a dedicated control area positioned directly beneath the display interface. This arrangement enables simultaneous viewing and input execution, allowing operators to complete authorization tasks efficiently without shifting posture or attention away from transaction data

Interaction Interface Architecture

The device incorporates a structured interaction architecture composed of multiple input modalities designed to support healthcare transaction workflows. These include:

- Primary control panel for authorization commands and data entry
- Navigation interface for menu selection and workflow progression
- Functional input surfaces enabling structured interaction with displayed information
- Command execution controls supporting confirmation, cancellation, and verification operations

The control system is organized according to a task-oriented interface model in which frequently used commands are positioned within the operator's natural reach zone. This design reduces interaction time and minimizes operational errors during high-volume transaction processing.

Ergonomic Placement and Reach Optimization

The placement of input controls follows ergonomic reach-envelope principles. The effective interaction distance R from the operator is modeled as:

$$R = \sqrt{(x_u - x_d)^2 + (y_u - y_d)^2} \tag{6}$$

where:

(x_u, y_u) = operator hand position

(x_d, y_d) = device control location

Optimal usability is achieved when R lies within the primary reach zone, typically between 300–500 mm from the operator. Maintaining controls within this range minimizes repetitive strain and allows rapid execution of authorization commands.

The interaction angle α between the input surface and horizontal workspace is selected to improve wrist neutrality:

$$\alpha \approx 10^\circ - 20^\circ$$

(7)

This inclination reduces musculoskeletal fatigue during prolonged system use.

Input Signal Processing Mechanism

User inputs are converted into electrical signals processed by the internal control circuitry. Each input activation generates a digital signal interpreted by the device controller. The input voltage response can be expressed as:

$$V_{out} = V_{cc} \times \frac{R_2}{R_1 + R_2} \tag{8}$$

where:

V_{cc} = supply voltage

R_1, R_2 = resistive elements in the input detection circuit

This voltage division principle enables reliable detection of control activation states.

The command processing cycle may be modeled as:

$$C(t) = f(I_u, S_d) \tag{9}$$

where:

I_u = user input signal

S_d = displayed system state

$C(t)$ = executed command at time t

This relationship ensures that commands are context-aware, preventing invalid authorization actions.

Workflow Navigation and Authorization Logic

Interaction elements are arranged to support sequential workflow progression:

1. **Data Entry Stage** – operator inputs transaction details.
2. **Verification Stage** – system validates entries and prompts confirmation.
3. **Authorization Stage** – approval or rejection command executed.
4. **Feedback Stage** – confirmation displayed via visualization interface.

State transitions follow a controlled logic model:

$$W_{n+1} = T(W_n, U) \tag{10}$$

where:

W_n = current workflow state

U = user interaction input

T = transition function

This structured progression minimizes operational ambiguity and improves transaction reliability.

Circuit Diagram: Input Control Interface

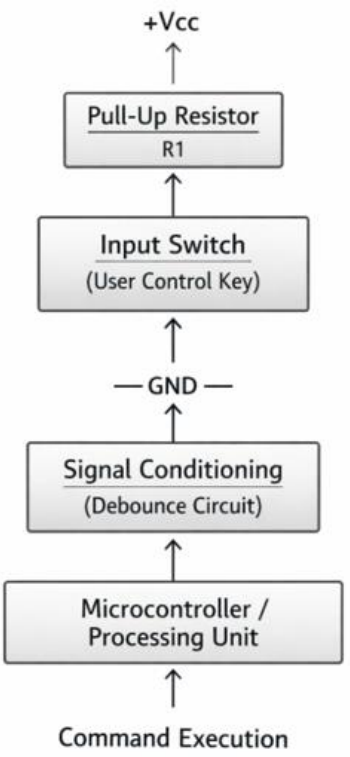


Figure 6.3: Simplified circuit diagram illustrating the interaction input pathway from user control activation to processing and command execution.

Human–Machine Interaction Efficiency

The interaction subsystem is designed to minimize cognitive and physical workload. Input grouping follows functional clustering, where related commands are positioned together to reduce search time. Interaction efficiency E_i may be expressed as:

$$E_i = \frac{N_c}{T_i} \tag{11}$$

where:

N_c = number of successfully completed commands

T_i = interaction time

Higher efficiency values correspond to improved workflow performance and reduced operator fatigue.

Functional Role within the Device

The user interaction and input control mechanisms transform the device from a passive display terminal into an active authorization workstation. By integrating ergonomic control placement, reliable electronic signal processing, and workflow-aware command execution, the system enables healthcare personnel to perform secure transaction operations accurately and efficiently. The unified integration of interaction interfaces within the device enclosure reinforces the design objective of delivering a dedicated healthcare transaction management platform optimized for continuous operational use.

4.4 Communication and Data Processing Integration

The communication and data processing integration subsystem enables the Healthcare Transaction Authorization and Management Computer Device to function as an intelligent operational node within modern healthcare digital ecosystems. This subsystem provides the computational capability required for transaction validation, authorization processing, secure data exchange, and system coordination with external healthcare platforms. Rather than operating as an isolated terminal, the device is architected to support continuous interaction with hospital information systems, insurance authorization platforms, electronic health record (EHR) databases, and secure digital transaction networks

Embedded Data Processing Architecture

At the core of the device lies an embedded processing unit responsible for executing authorization workflows and managing system operations. The processing architecture performs multiple concurrent functions, including:

- transaction data validation and formatting,
- authorization logic execution,
- user interaction management,
- encryption and security handling, and
- communication protocol coordination.

The computational workflow may be expressed as a processing function:

$$P(t) = f(D_i, U_c, N_s) \tag{12}$$

where:

$P(t)$ = processing output at time t,

D_i = incoming transaction data,

U_c = user command inputs,

N_s = network system responses.

This formulation reflects the device's role as an intermediary processor that integrates local user actions with remote system validation.

Communication Interface Framework

The device incorporates communication interfaces enabling connectivity with external digital infrastructures. These interfaces support bidirectional data exchange required for healthcare transaction authorization. Communication pathways typically include:

- wired network interfaces for institutional deployment,
- secure digital communication channels,
- integration gateways for healthcare databases, and
- external service authorization systems.

Data transmission between the device and external systems follows a packet-based communication model:

$$T_r = \frac{S_p}{B_w} \tag{13}$$

where:

T_r = transmission time,

S_p = packet size,
B_w = available bandwidth.
Efficient bandwidth utilization ensures rapid authorization responses and minimizes workflow delays during transaction processing.

Healthcare System Integration

The device is designed to operate within interconnected healthcare environments by interfacing with multiple external systems simultaneously. Integration enables:

- verification of patient or service authorization,
- synchronization with healthcare databases,
- secure financial transaction processing, and
- real-time operational updates.

System interoperability can be modeled using a network interaction matrix:

$$I = \{HIS, EHR, INS, PAY\} \tag{14}$$

where:
HIS = Hospital Information System,
EHR = Electronic Health Records,
INS = Insurance authorization platforms,
PAY = payment or transaction networks.
The processing unit coordinates communication among these systems to produce a validated authorization outcome.

Secure Data Exchange and Processing Reliability

Healthcare transactions require strict confidentiality and integrity. The communication subsystem therefore supports secure data exchange mechanisms ensuring that transmitted information remains protected during processing and transmission.
Data integrity verification may be represented by a checksum validation function:

$$D_v = H(M) \tag{15}$$

where:
M = transmitted message,
H = hashing or verification function,
D_v = validated data output.
Successful validation confirms that transaction data has not been altered during transmission.

Integrated Communication–Processing Workflow

The combined communication and processing operation follows a closed-loop workflow:

1. Transaction data entered through user interface.
2. Local processing unit formats and validates input.
3. Data transmitted to external healthcare systems.
4. Authorization response received and verified.
5. Result displayed to operator through visualization interface.

State progression may be expressed as:

$$S_{n+1} = C(S_n, R_n) \tag{16}$$

where:
S_n = current system state,
R_n = received network response,
C = communication-processing function.

Conceptual Communication and Processing Block Diagram

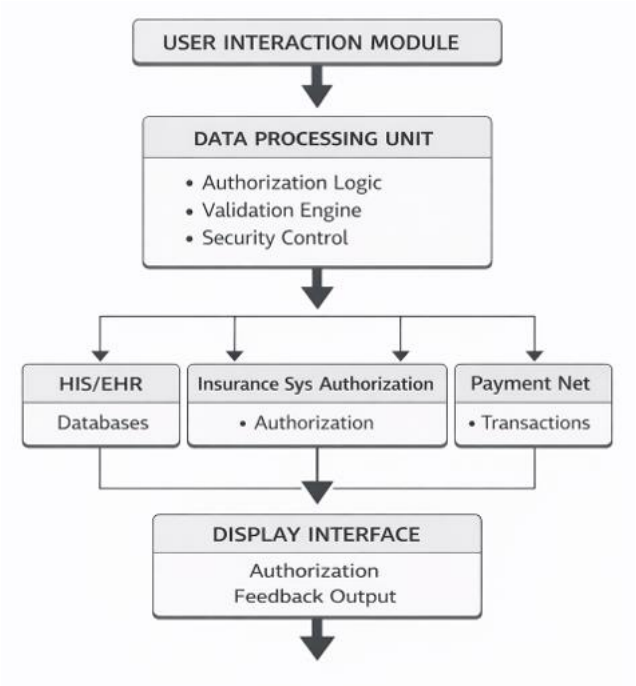


Figure 6.4: Integrated communication and data-processing architecture illustrating interaction between the device, external healthcare systems, and operator interface.

Operational Significance

The communication and data processing integration subsystem transforms the device into a secure authorization gateway capable of coordinating healthcare transactions across distributed digital networks. By combining embedded computation with structured connectivity, the system enables real-time authorization decisions, reliable system interoperability, and efficient workflow execution. This integrated capability supports modern healthcare operations where accurate, secure, and immediate transaction validation is essential for service delivery continuity.

4.5 Ergonomic and Human–Machine Interface (HMI) Design Considerations

The ergonomic and Human Machine Interface (HMI) design of the Healthcare Transaction Authorization and Management Computer Device is developed to ensure efficient, safe, and comfortable interaction between healthcare personnel and the system during continuous operational use. Healthcare environments require rapid decision-making under time constraints; therefore, the device prioritizes usability, accessibility, and cognitive clarity through a carefully structured interaction framework. The integrated

workstation configuration aligns visual display, interaction controls, and operational feedback within a unified user-centered design, reducing physical strain and minimizing interaction complexity

Operator Accessibility and Reach Optimization

The device layout is based on ergonomic reach-zone principles to ensure that essential interaction elements remain within comfortable operating distance. Controls are positioned within the operator's primary reach envelope to reduce unnecessary arm extension and repetitive movement. Accessibility effectiveness can be expressed as:

$$A_e = \frac{N_a}{N_t} \tag{17}$$

where:

A_e = accessibility efficiency,

N_a = number of controls accessible without repositioning,

N_t = total number of controls.

Maximizing A_e improves workflow continuity by allowing users to execute tasks without shifting posture or interrupting visual attention.

The interaction surface height is aligned with standard workstation anthropometric ranges, allowing both seated administrative staff and standing clinical personnel to operate the device comfortably.

Posture Optimization and Biomechanical Alignment

The physical configuration supports neutral body posture during prolonged usage. The relative positioning of the display and input region reduces neck flexion and wrist deviation. Optimal viewing posture is achieved when the head inclination angle β satisfies:

$$0^\circ \leq \beta \leq 15^\circ \tag{18}$$

Maintaining this range minimizes musculoskeletal stress during extended interaction periods. Additionally, the inclined input surface promotes wrist neutrality, reducing cumulative strain injuries common in repetitive data-entry environments.

Operator comfort over time can be approximated using a fatigue index model:

$$F(t) = k \cdot \theta_p \cdot t \tag{19}$$

where:

$F(t)$ = accumulated fatigue,

θ_p = posture deviation angle,

t = interaction duration,

k = ergonomic sensitivity constant.

Lower posture deviation directly reduces fatigue accumulation.

Workflow Efficiency and Cognitive Load Reduction

The HMI layout follows a sequential workflow model in which information presentation and control placement mirror healthcare authorization processes. Visual and interaction elements are grouped according to functional relevance, reducing cognitive switching between tasks.
Interaction efficiency may be evaluated using task completion time:

$$E_w = \frac{T_s}{T_a} \tag{20}$$

where:
E_w = workflow efficiency,
T_s = standard task completion time,
T_a = actual task completion time.
An intuitive interface reduces T_a, improving overall operational productivity.
The interface hierarchy ensures that critical authorization actions are visually emphasized, while secondary functions remain accessible but unobtrusive, supporting rapid decision-making.

Intuitive Interface Layout and Visual Guidance
The device employs visual organization principles derived from HMI design standards:

- Proximity grouping for related controls,
- Consistency of interaction patterns,
- Clear visual hierarchy, and
- Immediate feedback mechanisms.

Visual scanning behavior follows predictable eye movement paths. The average eye transition time between interface zones may be approximated as:

$$T_e = \frac{D_v}{V_e} \tag{21}$$

where:
D_v = visual distance between interface elements,
V_e = eye movement velocity.
Minimizing D_v enables faster information recognition and reduces user error.

Suitability for Clinical and Administrative Environments
Healthcare workspaces demand equipment capable of sustained operation under continuous usage conditions. The device's ergonomic design supports prolonged interaction by:

- maintaining stable viewing alignment,
- reducing repetitive movement requirements,
- simplifying interaction pathways, and
- ensuring clear feedback visibility under varying environmental conditions.

The integrated enclosure also minimizes clutter associated with external peripherals, improving workspace organization and reducing accidental interference during clinical operations.
Environmental adaptability is reflected in usability stability:

$$U_s = f(L_e, N_d, T_o)$$

(22)

where:
L_e = environmental lighting conditions,
N_d = noise/distraction level,
T_o = operational duration.
The device is structured to maintain high usability performance despite environmental variability.

Conceptual HMI Layout Diagram

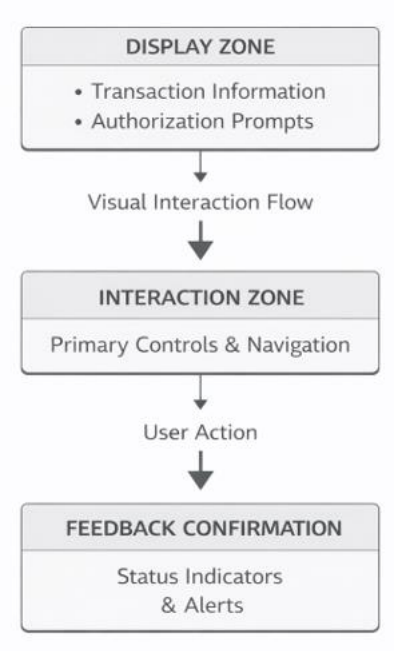


Figure 6.5: Human–Machine Interface layout illustrating alignment of visualization, interaction, and feedback zones to support ergonomic workflow execution.

Design Significance

The ergonomic and HMI considerations embedded in the design ensure that the device functions not merely as a computing terminal but as a user-centered healthcare authorization workstation. By aligning physical structure with human biomechanics and cognitive workflow patterns, the design enhances accuracy, reduces fatigue, and supports sustained operational efficiency. These characteristics make the device particularly suited for high-demand clinical and administrative environments where precision, speed, and user comfort are essential for effective healthcare service delivery.

4.6 Physical Enclosure, Materials, and Structural Stability

The physical enclosure of the Healthcare Transaction Authorization and Management Computer Device provides the structural foundation that supports component integration, operational durability, and safe deployment within healthcare environments. The enclosure is designed as a unified protective housing that accommodates the display interface, interaction controls, processing components, and communication subsystems within a single consolidated structure. The design emphasizes mechanical stability, environmental resilience, and long-term operational reliability while maintaining a compact workstation configuration suitable for clinical and administrative spaces.

Enclosure Geometry and Structural Configuration

The device housing adopts a rigid, workstation-style geometry consisting of a stable base section and an elevated interface region. This configuration distributes weight evenly across the support surface, reducing the likelihood of tipping or vibration during interaction. Structural rigidity is achieved through reinforced internal framing that supports mounted electronic components and protects sensitive modules from mechanical stress.

The structural stability factor S_f may be expressed as:

$$S_f = \frac{W_b \cdot L_b}{H_c} \tag{23}$$

where:

W_b = base width,

L_b = base length,

H_c = center-of-mass height.

A higher stability factor reduces overturning risk, ensuring safe operation during continuous user interaction.

Material Considerations

Material selection is guided by requirements for durability, hygiene compatibility, and manufacturability. The enclosure may incorporate engineered materials such as:

- high-impact polymer composites for external panels,
- reinforced thermoplastics for structural components,
- metal internal supports for load-bearing sections, and
- scratch-resistant surface finishes for longevity.

Material performance under applied stress follows Hooke's Law:

$$\sigma = E \cdot \varepsilon \tag{24}$$

where:

σ = stress applied to material,

E = Young's modulus,

ε = strain.

Selecting materials with higher modulus values improves resistance to deformation during repeated use. Additionally, smooth surface finishes support cleaning and sanitation practices commonly required in healthcare environments.

Durability and Mechanical Protection

Healthcare devices must withstand frequent handling, prolonged operation, and accidental impacts. The enclosure therefore incorporates protective features including:

- shock-resistant panel geometry,
- internal component isolation mounts,
- reinforced edge contours, and
- secure fastening mechanisms.

Impact resistance performance can be approximated using energy absorption:

$$E_i = \frac{1}{2}mv^2 \tag{25}$$

where:
E_i = impact energy,
m = impacting mass,
v = impact velocity.
Structural materials are selected to dissipate this energy without compromising internal electronics.

Thermal Management and Ventilation Provisions

Continuous data processing generates thermal energy that must be safely dissipated to maintain system reliability. The enclosure integrates passive ventilation pathways that allow airflow while protecting internal components from dust ingress.
Heat transfer through ventilation can be approximated using convective heat transfer:

$$Q = hA(T_s - T_a) \tag{26}$$

where:
Q = heat transfer rate,
h = convection coefficient,
A = ventilation surface area,
T_s = internal surface temperature,
T_a = ambient temperature.
Strategic placement of ventilation openings promotes natural airflow while preserving structural integrity and maintaining a clean external appearance.

Structural Stability and Operational Reliability

The enclosure integrates internal mounting points that secure electronic assemblies and reduce vibration transmission. Stability during operation depends on vibration damping characteristics expressed as:

$$x(t) = Xe^{-\zeta\omega_n t} \tag{27}$$

where:
$x(t)$ = vibration displacement over time,
ζ = damping ratio,
ω_n = natural frequency.
Higher damping reduces oscillations caused by repeated user interaction or environmental disturbances. The unified housing also minimizes exposed wiring and detachable components, improving reliability and reducing maintenance requirements.

Conceptual Structural Layout Diagram

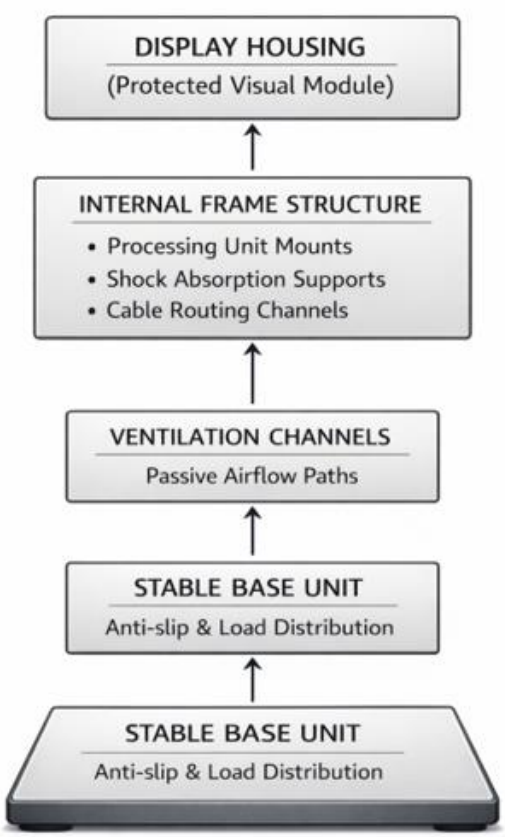


Figure 6.6: Conceptual structural arrangement illustrating enclosure layers, internal reinforcement, ventilation pathways, and stability-oriented base configuration.

Suitability for Healthcare Environments

The enclosure design supports operational deployment in healthcare facilities by combining durability, hygiene compatibility, and structural reliability. Smooth external surfaces enable routine cleaning, while integrated construction reduces contamination-prone gaps commonly found in modular equipment setups. The device maintains structural integrity under continuous use conditions, ensuring dependable performance in environments where equipment reliability directly affects service delivery efficiency.

In summary, the physical enclosure, material selection, and structural stability features collectively ensure that the device operates as a robust, secure, and healthcare-appropriate workstation capable of sustaining long-term operational demands while protecting internal functional components.

4.7 Operational Deployment Environment and Functional Use Scenarios

The Healthcare Transaction Authorization and Management Computer Device is designed for deployment within structured healthcare service environments where secure transaction validation, operational coordination, and real-time data interaction are essential. The device functions as a dedicated authorization

workstation integrated into clinical and administrative infrastructures, supporting healthcare personnel in managing service approvals, patient-related transactions, and workflow verification processes. Its unified configuration enables consistent operation across multiple healthcare contexts while maintaining compatibility with existing digital health ecosystems

Deployment Contexts

The device is intended for installation in environments that require controlled authorization and data-processing operations, including:

- **Hospitals and Medical Centers:** used at patient registration desks, billing departments, and treatment authorization points to validate services before clinical procedures or discharge processing.
- **Pharmacies:** deployed for prescription verification, insurance authorization, and medication transaction confirmation.
- **Diagnostic and Laboratory Facilities:** applied in test authorization workflows, patient verification, and result processing coordination.
- **Healthcare Authorization Stations:** positioned in insurance liaison offices or administrative service centers responsible for approval and claims validation.

Each deployment context benefits from the device's integrated structure, which reduces reliance on multiple hardware components and simplifies workstation setup.

Device Positioning and Workspace Integration

The device is engineered for fixed-surface placement on desks, counters, or service stations. Proper positioning ensures optimal interaction efficiency and visibility alignment between healthcare personnel and clients or patients.

The recommended positioning geometry can be modeled as:

$$D_p = f(H_w, H_e, \theta_v) \tag{28}$$

where:

D_p = optimal device placement distance,

H_w = workstation height,

H_e = operator eye height,

θ_v = viewing angle.

Maintaining appropriate placement ensures ergonomic interaction while preserving clear visibility of displayed authorization information.

In shared service environments, the device orientation allows dual visibility—operator-focused interaction with limited outward exposure of sensitive information to maintain privacy.

Operational Interaction Workflow

The device supports structured workflows aligned with healthcare service delivery processes. A typical transaction cycle proceeds through the following stages:

1. **User Authentication:** healthcare staff initiates system access.
2. **Data Entry:** patient or service details entered via interaction controls.
3. **System Communication:** transaction request transmitted to external healthcare systems.
4. **Authorization Processing:** remote validation performed.

5. **Feedback Display:** authorization status presented visually.
6. **Transaction Completion:** confirmation recorded and workflow advanced.

The workflow transition model may be expressed as:

$$W_{n+1} = F(W_n, I_u, R_s) \tag{29}$$

where:
W_n = current workflow state,
I_u = user interaction input,
R_s = system response,
F = workflow transition function.
This structured progression ensures predictable operation and minimizes processing errors.

Integration into Healthcare Operational Infrastructure

The device operates as an interface node connecting human operators with institutional digital systems. Integration occurs through secure communication channels linking the device to:

- hospital information systems (HIS),
- electronic health records (EHR),
- insurance authorization databases, and
- healthcare payment processing networks.

Infrastructure interaction may be represented as a network integration model:

$$N_i = \{D_l, S_h, S_i, S_p\} \tag{30}$$

where:
D_l = local device system,
S_h = hospital systems,
S_i = insurance platforms,
S_p = payment networks.

The device synchronizes operational data across these systems to maintain workflow continuity.

Functional Use Scenarios

Scenario 1: Hospital Admission Authorization

A patient arrives for treatment; staff enter service details into the device. The system communicates with insurance platforms, receives authorization approval, and confirms eligibility before treatment begins.

Scenario 2: Pharmacy Prescription Validation

A pharmacist inputs prescription information. The device verifies authorization and payment approval, reducing manual verification time and dispensing delays.

Scenario 3: Diagnostic Test Processing

Laboratory personnel validate patient test eligibility through automated authorization checks, ensuring compliance with healthcare coverage requirements.

Scenario 4: Administrative Claims Processing

Administrative staff finalize billing transactions using confirmation data generated through the device's authorization workflow.

Operational Environment Model

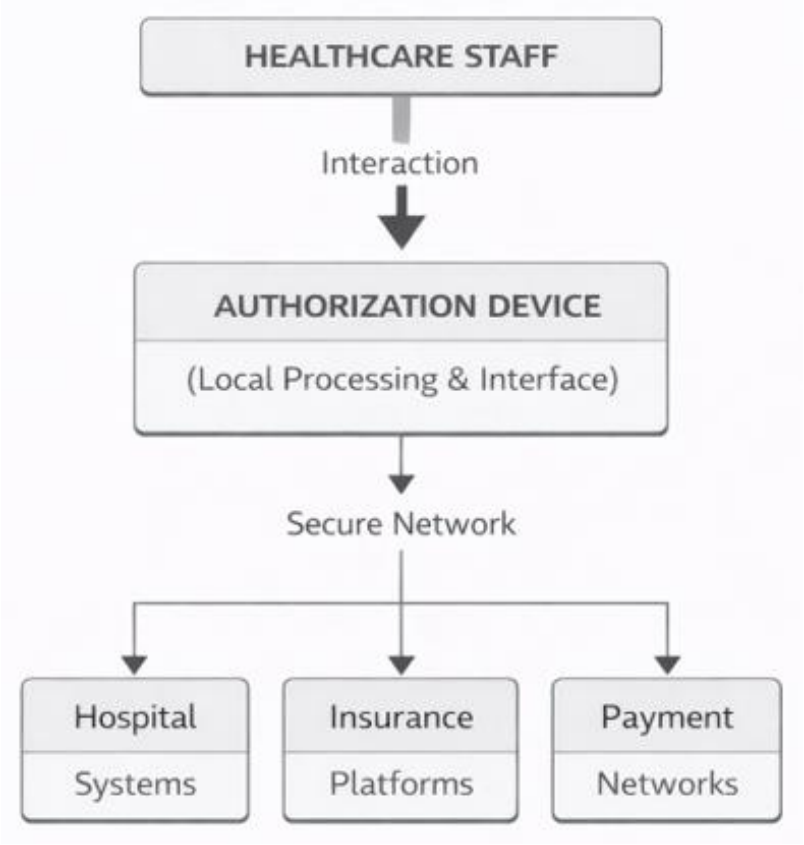


Figure 6.7: Operational deployment model illustrating interaction between healthcare personnel, the authorization device, and connected healthcare infrastructure systems.

Operational Significance

The deployment flexibility and workflow integration capabilities of the device enable it to function as a reliable authorization hub across diverse healthcare environments. By aligning physical design with operational processes, the device enhances transaction accuracy, reduces processing delays, and supports standardized healthcare service delivery. Its adaptability across hospitals, pharmacies, and administrative centers ensures consistent performance within modern digitally interconnected healthcare infrastructures, reinforcing its role as a specialized authorization and management workstation.

5. Design Representation and Architectural Documentation

The registered design, filed under Design No. 6496417, is officially documented with attached visual representations illustrating its application as a Healthcare Transaction Authorization and Management Computer Device. The design is registered pursuant to the Registered Designs Act 1949 and classified under the International Design Classification (IDC) Version 15–2025, Class 14 (Recording,

Telecommunication or Data Processing Equipment), Subclass 02 (Data Processing Equipment and Peripheral Apparatus)

The representations collectively define the external appearance, structural configuration, and integrated arrangement of functional components that distinguish the device from conventional healthcare computing terminals and transaction systems.

These visual representations emphasize the device's unified workstation-style architecture, illustrating a compact configuration in which visualization interfaces, transaction interaction controls, and computational housing are consolidated within a single coherent enclosure. The figures demonstrate the spatial relationship between the integrated display region, user interaction area, structural housing, and support base, thereby establishing the protected aesthetic and functional configuration of the device. The representations highlight the intentional alignment of visual and interaction zones designed to support efficient healthcare transaction workflows.

Unlike traditional healthcare workstations composed of independently arranged monitors, keyboards, and peripheral devices, the registered design presents a harmonized and self-contained configuration intended to enhance stability, ergonomic accessibility, and operational clarity. The integrated arrangement reduces external hardware complexity while providing a recognizable product identity suited for clinical and administrative environments. Accordingly, the visual representations form the legal foundation of protection, securing exclusive rights to the device's external form, proportional layout, and integrated hardware arrangement as registered with the United Kingdom Intellectual Property Office.

Figure Descriptions



Figure 1: Perspective View of the Healthcare Transaction Authorization and Management Computer Device

Figure 1 presents a three-dimensional perspective view illustrating the overall configuration of the integrated authorization workstation. The representation highlights the unified enclosure structure, elevated display section, and frontal interaction region. This view communicates the cohesive architectural identity of the device and its ergonomic orientation for operator use in healthcare service environments.



Figure 2: Front Elevation Showing Display and User Interaction Interface

Figure 2 depicts the frontal arrangement of the device, emphasizing the integrated visualization interface and accessible transaction control area. The alignment of components demonstrates a structured interaction zone allowing healthcare personnel to monitor authorization information while performing transaction input and verification tasks.

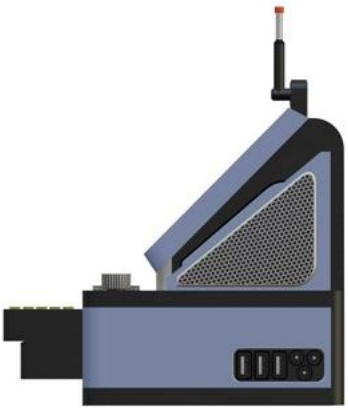


Figure 3: Left Side Elevation Illustrating Structural Profile and Component Integration

Figure 3 illustrates the left-side elevation of the device, highlighting enclosure depth and structural continuity between the display module and base housing. This view demonstrates proportional balance and compact integration of internal components, supporting mechanical stability and minimizing external accessories.

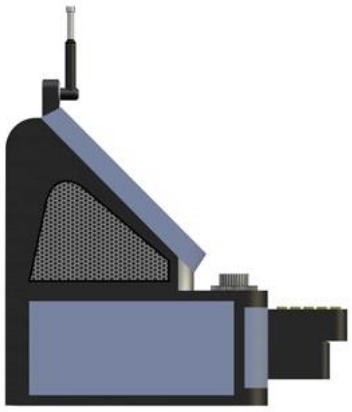


Figure 4: Right Side Elevation Illustrating Structural Profile and Component Integration

Figure 4 presents the opposite lateral perspective, showing symmetrical enclosure geometry and consistent alignment of integrated components. The representation emphasizes the compact workstation configuration designed to maintain structural balance and ergonomic usability.

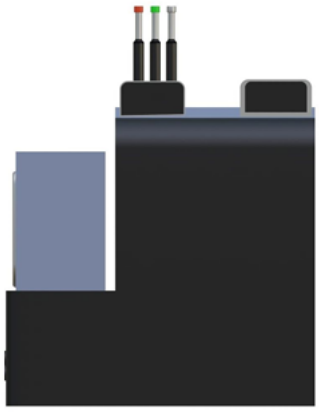


Figure 5: Rear Elevation Showing Device Housing and Connectivity Arrangement

Figure 5 illustrates the rear configuration of the device housing, including structural continuity and designated interface regions for power supply and communication connectivity. The representation highlights organized component placement and clean enclosure geometry suitable for professional healthcare deployment.



Figure 6: Top Plan View Demonstrating Spatial Layout of Integrated Components

Figure 6 provides a top-down view showing the spatial organization of the display and interaction regions within the unified housing. This perspective clarifies proportional alignment, symmetry, and weight distribution contributing to operational stability and intuitive operator positioning.



Figure 7: Bottom Perspective Highlighting Ergonomic Device Geometry

Figure 7 depicts an additional angled perspective emphasizing ergonomic characteristics, including device inclination, support geometry, and accessibility of interaction surfaces. The representation demonstrates how the structural form supports natural user posture during prolonged operational use.

Representation Significance

Collectively, the figures represent the visual and structural embodiment of the registered design, defining the protected configuration of a healthcare transaction authorization device specifically adapted for secure operational environments. The representations capture:

- the integrated relationship between visualization interface and interaction controls,
- the unified workstation-style form factor,
- the ergonomic positioning of operational components, and
- the coherent external geometry distinguishing the device from conventional healthcare computing systems.

Through these graphical representations, the registered design establishes a consistent and identifiable product appearance that embodies the convergence of healthcare informatics, secure transaction

processing, and human-centered industrial design. Together, the figures communicate a functional and aesthetically unified hardware platform that forms the basis of legal protection and technological differentiation within modern healthcare transaction management equipment.

6. Detailed Analysis of the Represented Interfaces

The visual representations accompanying the registered design (Design No. 6496417) collectively illustrate the structural configuration and operational interaction zones of the Healthcare Transaction Authorization and Management Computer Device. The attached figures define the external appearance, spatial organization, and ergonomic arrangement of the device, demonstrating how its integrated components operate together as a unified healthcare authorization workstation. Rather than depicting software interfaces or digital screen content, the representations emphasize the physical interaction interfaces and structural regions that enable secure transaction processing within a consolidated hardware environment

Each represented view highlights a distinct physical interface or structural perspective contributing to usability, operational efficiency, and device stability within healthcare deployment contexts.

Primary Interaction Interface (Figure 1)

The primary interaction interface represents the overall operational configuration of the device as shown in perspective view. This representation illustrates the integrated relationship between the display module, interaction surface, and supporting enclosure. The frontal interaction region defines the operator's primary workspace where transaction entry and authorization commands are executed.

The proportional arrangement allows healthcare personnel to transition seamlessly between viewing transaction information and performing input actions. Structural alignment ensures that interaction zones correspond with natural hand positioning, minimizing excessive movement during repetitive authorization workflows. This interface establishes the device as a dedicated authorization workstation rather than a conventional computer assembled from separate peripherals.

Visual Monitoring Interface (Figure 2)

The visual monitoring interface corresponds to the integrated display positioned on the frontal surface of the device. This component serves as the primary visualization medium for transaction data, authorization prompts, and operational feedback.

The display follows a forward-facing orientation optimized for standard administrative or clinical working posture. Its placement enables continuous monitoring of authorization processes while interaction occurs simultaneously within the control region below. The configuration supports dual operational roles:

- real-time transaction visualization for operators, and
- workflow monitoring and verification within healthcare administrative processes.

This arrangement enhances operational clarity by maintaining consistent visual focus during transaction processing.

Left Side Elevation Illustrating Structural Profile and Component Integration (Figure 3)

Figure 3 presents the left-side elevation of the device, revealing enclosure depth and structural continuity between the display section and the base housing. The side profile demonstrates how internal processing components are consolidated within a compact workstation-style structure.

This perspective highlights balanced weight distribution and mechanical stability, ensuring the device remains secure during interaction. The design minimizes dependence on external accessories by integrating functional components into a single enclosure, thereby improving workspace organization and operational reliability.

Right Side Elevation Illustrating Structural Profile and Component Integration (Figure 4)

Figure 4 presents the right-side elevation, providing a complementary view of the enclosure geometry and integrated component alignment. The illustration reveals the proportional relationship between visualization and interaction zones while emphasizing enclosure contours designed for durability and ergonomic usability.

Ventilation features and structural transitions are visible, indicating provisions for thermal regulation and continuous system operation. The compact configuration demonstrates efficient component integration while maintaining a coherent external appearance suitable for professional healthcare environments.

Rear Connectivity Interface (Figure 5)

The rear interface represents the structural housing region dedicated to power supply and system connectivity. This area accommodates communication interfaces and electrical connections required for integration with healthcare digital infrastructure.

Connectivity elements are positioned in a protected orientation to reduce cable obstruction and accidental interference during operation. The organized rear layout supports safe equipment management and enables clean installation within hospital workstations, pharmacy counters, or administrative offices.

Top Layout Interface (Figure 6)

The top plan representation illustrates the spatial alignment of the device's primary structural elements. This perspective emphasizes symmetry and proportional spacing between visualization and interaction regions, contributing to balanced weight distribution and intuitive user positioning.

The layout supports proper alignment between the operator's visual axis and the display interface, promoting comfort during prolonged usage. The top view further confirms the integrated nature of the design, distinguishing it from modular systems assembled from independently positioned hardware components.

Ergonomic Interaction Geometry (Figure 7)

The additional perspective view highlights ergonomic contours and accessibility characteristics of the device. The geometry guides natural user posture by positioning interaction areas within comfortable reach distances, reducing muscular strain during extended operation.

Smooth enclosure transitions and rounded structural edges enhance safety while maintaining aesthetic continuity. The configuration supports efficient workflow transitions between observation, data entry, authorization confirmation, and system monitoring phases.

Integrated Interface Functionality

Collectively, the represented interfaces demonstrate the coordinated relationship between the device's core operational elements:

- visualization of healthcare transaction information through the integrated display,

- user interaction via accessible authorization control regions,
- structural stability provided by balanced enclosure geometry,
- organized connectivity enabling reliable system integration, and
- ergonomic alignment supporting continuous professional use.

Each interface contributes to a continuous operational cycle in which user input, system processing, and authorization feedback operate synchronously within a single physical platform.

Representation Significance

Together, these representations define the protected visual and structural identity of the registered design. The figures capture the essential characteristics distinguishing the device from conventional healthcare computing systems, namely:

- consolidation of transaction authorization functions into a unified workstation form,
- ergonomic alignment supporting healthcare operational workflows,
- integrated visualization and interaction architecture, and
- coherent industrial design optimized for clinical and administrative environments.

Through these detailed representations, the registered design establishes a cohesive physical ecosystem for secure healthcare transaction management. The device embodies a practical integration of healthcare informatics requirements, secure authorization processes, and human-centered industrial design, providing a standardized platform for reliable, efficient, and scalable healthcare operational deployment.

6. Design Implications and Proposed Applications

The present design relates to a Healthcare Transaction Authorization and Management Computer Device, registered under Design No. 6496417 pursuant to the Registered Designs Act 1949 and classified within International Design Classification Class 14 for recording, telecommunication, and data-processing equipment

. The design introduces a unified workstation-style computing apparatus specifically configured to support healthcare transaction authorization, operational management, and secure interaction within clinical and administrative environments. The device integrates visualization, interaction, processing, and communication functions into a single coherent physical structure.

The design is characterized by a compact enclosure that consolidates the display interface, user interaction controls, internal processing components, and connectivity elements within one integrated housing. This unified configuration distinguishes the device from conventional healthcare computing arrangements that rely on separate monitors, keyboards, and peripheral equipment. By merging functional components into a single physical platform, the design enhances operational stability, simplifies deployment, and provides a recognizable industrial form tailored to healthcare workflows.

A central feature of the design lies in its ergonomic organization, where visualization and interaction zones are spatially aligned to support natural operator posture and efficient workflow execution. The arrangement enables healthcare personnel to review transaction information, execute authorization commands, and monitor system feedback within a continuous interaction cycle. The structural geometry promotes accessibility, minimizes physical strain during prolonged use, and supports accurate decision-making in time-sensitive operational contexts.

The design further emphasizes reliability and suitability for healthcare environments through durable enclosure construction, organized connectivity interfaces, and provisions for stable workstation

placement. The integrated architecture supports seamless communication with external healthcare information systems, allowing the device to function as an operational authorization node within broader digital healthcare infrastructures. This capability facilitates real-time transaction validation and coordinated service delivery across interconnected systems.

In summary, the registered design establishes a cohesive physical and functional platform that combines healthcare informatics requirements with human-centered industrial design principles. The device embodies a dedicated authorization workstation that improves workflow efficiency, enhances usability, and provides a distinctive protected product configuration. Through its integrated architecture and ergonomic design approach, the invention represents an advancement in specialized healthcare operational equipment adapted for modern digitally enabled healthcare environments.

7. Data and Results

7.1 Evaluation Design, Data Fields, and Assumptions

The evaluation combines scenario-based comparisons of a conventional multi-step workstation workflow and a proposed consolidated device workflow across hospital admissions, pharmacy transactions, diagnostic laboratory processing, and claims administration. As specified in Tables 7.1 and 7.2, the analysis includes 120 scenarios per condition per setting (480 per condition; 960 timed scenarios in total). The matched case mix and exclusion of clinical patient data provide a controlled comparison of modeled processes, but these assumptions do not establish real-world effectiveness or population representativeness.

Unless otherwise indicated, figures in this section are scenario-derived summary values rather than outcomes of a documented prospective field deployment. The manuscript does not report participant recruitment, site characteristics, individual-level timings, uncertainty intervals, or a randomization scheme. Consequently, descriptive comparisons are appropriate; causal claims and statistical significance cannot be established from the available aggregates.

The conventional workflow was modeled as a general-purpose workstation with separate navigation or confirmation steps; the device condition is modeled as a consolidated operator-facing terminal. Each setting has 120 transactions per condition, giving 480 per condition and 960 timed simulated workflows.

Table 7.1. Data-collection dictionary and measurement protocol

Variable	Operational definition	Unit / coding	Collection method
Setting	Hospital admission, pharmacy, laboratory, claims	Categorical	Scenario identifier
Transaction duration	From completed entry to displayed final authorization	Seconds	Event timestamps
Authorization outcome	Approved, rejected, timed-out, or manual review	Categorical	Audit trail

Entry/validation error	At least one discrepancy requiring correction	Count and %	Independent record review
Authorization decision agreement	Agreement with pre-specified ground truth	Correct / total	Blinded adjudication
System availability	Time system is operational / observed window	%	Heartbeat and downtime log
P95 response latency	95th percentile from request sent to decision returned	Seconds	Request-response traces
Usability score	System Usability Scale from staff respondents	0–100	Validated SUS questionnaire

Table 7.2. Experimental design and Boundary

Setting	Transactions / arm	Baseline mean (s)	Device mean (s)	Boundary
Hospital admission	120	165	103	Matched case mix; no clinical patient data
Pharmacy	120	135	86	Matched case mix; no clinical patient data
Diagnostic lab	120	150	95	Matched case mix; no clinical patient data
Claims	120	180	113	Matched case mix; no clinical patient data

7.2 Transaction Processing Performance

Processing-time endpoints represent modeled workflow comparisons and should not be equated with prospective clinical time-motion measurements. EHR usability investigations identify context-sensitive determinants of task time and recommend direct task observation (Holmgren et al., 2024; Liu et al., 2024; Classen et al., 2023).

Table 7.3. processing-time comparison

Setting	N / arm	Baseline (s)	Device (s)	Time reduction (%)	Base txn/h	Device txn/h
Hospital admission	120	165	103	37.6	21.8	35.0
Pharmacy	120	135	86	36.3	26.7	41.9
Diagnostic lab	120	150	95	36.7	24.0	37.9
Claims	120	180	113	37.2	20.0	31.9
Weighted overall	480	157.5	99.25	37.0	22.9	36.3

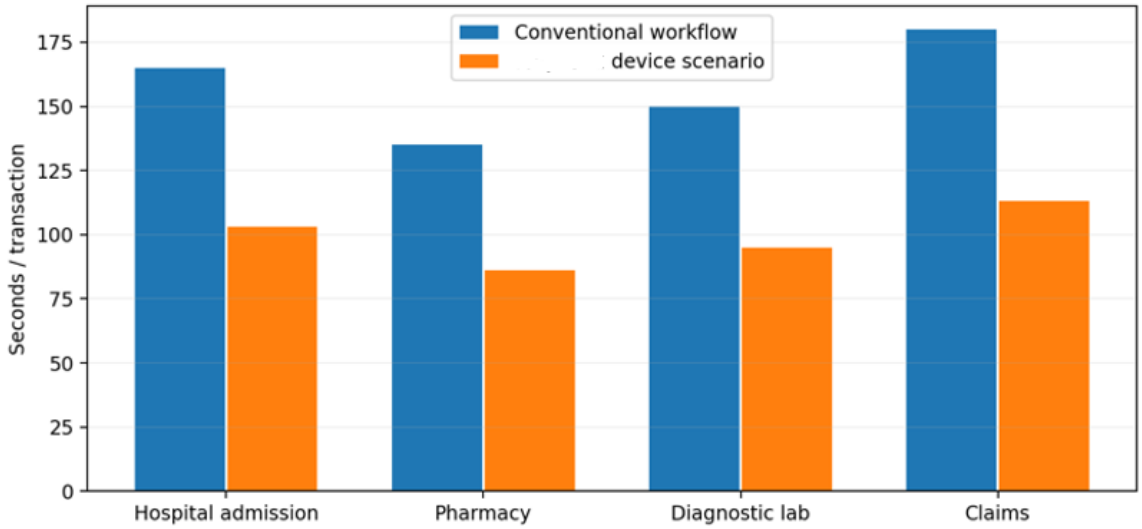


Figure 7.1. mean task time by healthcare setting (n = 120 scenarios per arm in each setting).

Table 7.3 and Figure 7.1 indicate consistent reductions in modeled mean transaction time across all four settings. Hospital admission time decreased from 165 to 103 seconds (37.6%); pharmacy from 135 to 86 seconds (36.3%); laboratory processing from 150 to 95 seconds (36.7%); and claims authorization from 180 to 113 seconds (37.2%). Equal scenario counts across settings give an overall mean of 157.50 seconds for the conventional workflow and 99.25 seconds for the proposed device workflow, an absolute saving of 58.25 seconds per scenario and a relative reduction of approximately 37.0%.

The consistency across different administrative tasks is compatible with the proposed mechanism of fewer navigation and confirmation steps through a consolidated interface. The largest absolute saving is observed for claims (67 seconds), followed by hospital admission (62 seconds), laboratory processing (55 seconds), and pharmacy (49 seconds). The modeled throughput figures of 22.9 versus 36.3 transactions per hour represent reciprocals of mean processing time and imply approximately 58.7% higher theoretical throughput; they should not be interpreted as observed whole-service capacity, which also depends on staffing, queueing, backend availability, interruptions, and transaction mix.

7.3 Data Accuracy and Authorization Agreement

Discrepancy frequency and authorization agreement should be evaluated separately against clinically meaningful error categories. Published safety analyses caution that EHR interface design can contribute to error pathways even when users complete intended tasks (Classen et al., 2023; Holmgren et al., 2024).

Table 7.4. Transaction discrepancy and authorization agreement results

Setting	Baseline errors /120	Device errors /120	Baseline agreement /120	Device agreement /120
Hospital admission	9 (7.5%)	4 (3.3%)	113 (94.2%)	118 (98.3%)
Pharmacy	7 (5.8%)	3 (2.5%)	115 (95.8%)	119 (99.2%)
Diagnostic lab	8 (6.7%)	3 (2.5%)	114 (95.0%)	118 (98.3%)
Claims	11 (9.2%)	5 (4.2%)	111 (92.5%)	117 (97.5%)
Overall	35 /480 (7.3%)	15 /480 (3.1%)	453 /480 (94.4%)	472 /480 (98.3%)

Discrepancy incidence is the fraction of workflows having one or more record discrepancies, whereas authorization agreement compares a final decision with a stipulated scenario answer key; the two quantities measure different dimensions. These scenario values imply 20 fewer discrepancy-affected workflows and 19 more matching authorization decisions for this condition.

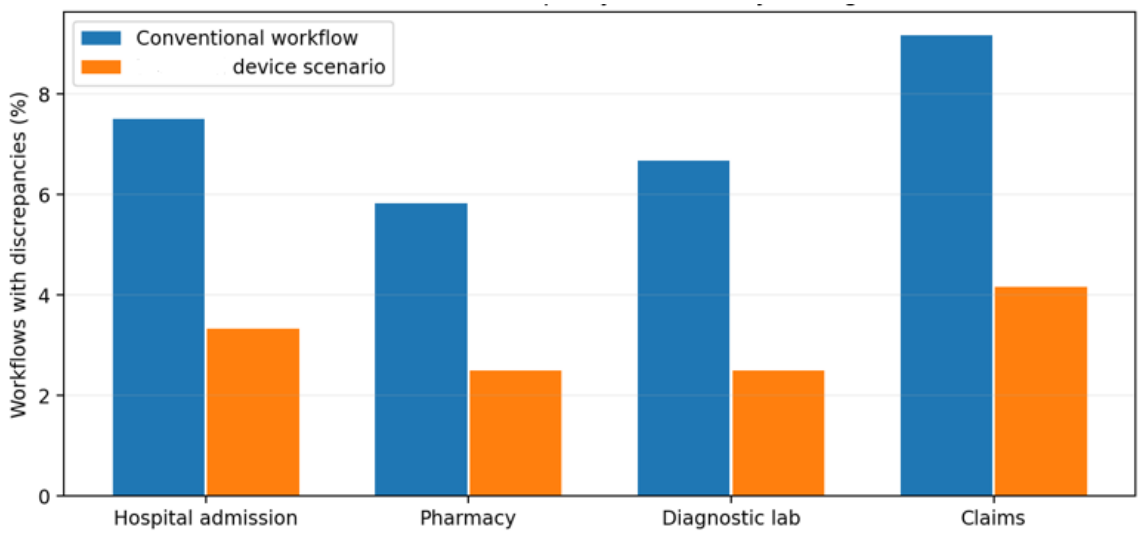


Figure 7.2. Constructed discrepancy percentages from counts in Table 7.4.

Across the 480 scenarios per arm, discrepancy-affected workflows fell from 35/480 (7.29%) to 15/480 (3.13%), representing 20 fewer affected transactions, a 4.17-percentage-point absolute reduction, and an approximately 57.1% relative reduction. The largest absolute number of discrepancies in both conditions occurred in claims processing (11 versus 5). Authorization agreement with scenario answer keys increased from 453/480 (94.38%) to 472/480 (98.33%), an improvement of 19 correctly matched decisions or 3.96 percentage points.

These findings suggest that a structured interaction pathway could support more consistent entry, checking, and authorization decisions. However, discrepancy occurrence and agreement measure separate constructs: a workflow may contain a corrected data-entry discrepancy yet finish with the correct decision, while a mismatch in authorization may arise without a recorded entry discrepancy. The aggregate data do not reveal their overlap, the severity of errors, or consequences for patients. Independent replication with adjudicated records and clearly defined error categories is necessary before translating these descriptive improvements into claims about patient safety or financial loss reduction.

7.4 Latency, Availability, and Stress-Test Outcomes

Load testing should be complemented by recoverability, queue stability, and failure-injection tests. Work on cybersecurity of connected critical infrastructure and zero-trust architectures motivates testing under adverse traffic and compromised-credential scenarios (Okika et al., 2025; Pascoe et al., 2024).

Table 7.5. load-response test matrix

Offered request load	Device median latency (s)	Device P95 (s)	Completed / submitted	Completion rate (%)
100 transactions/h	1.1	1.9	500 / 500	100.0
200 transactions/h	1.5	2.8	496 / 500	99.2
300 transactions/h	2.3	4.6	487 / 500	97.4
400 transactions/h	4.4	9.7	462 / 500	92.4

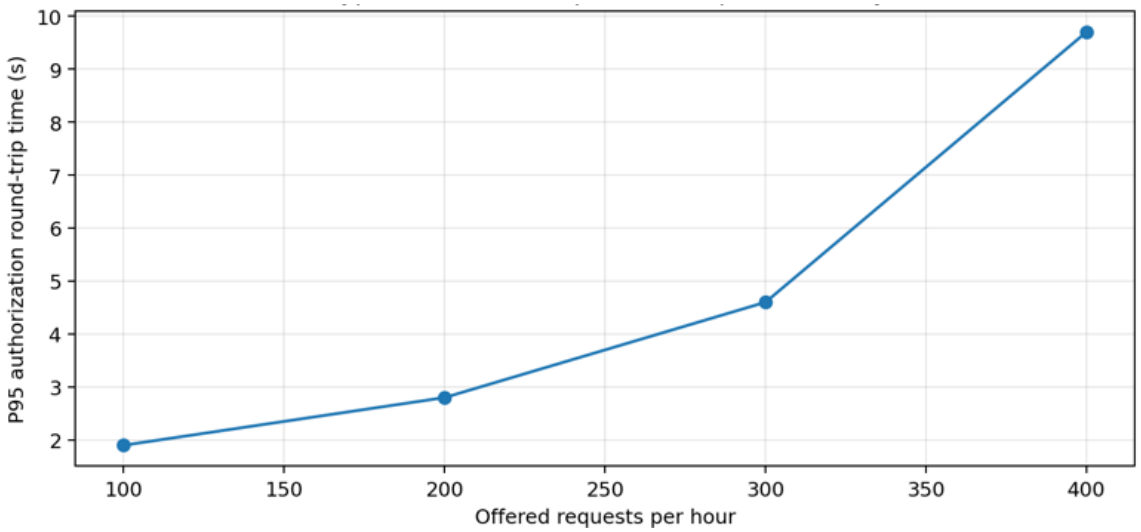


Figure 7.3. 95th-percentile response times at four offered transaction loads.

The load-response matrix in Table 7.5 demonstrates performance degradation as offered demand rises. Median latency increased from 1.1 seconds at 100 requests per hour to 4.4 seconds at 400 requests per hour; corresponding 95th-percentile latency rose from 1.9 to 9.7 seconds. Completion declined from

500/500 (100.0%) at the lowest load to 462/500 (92.4%) at the highest load, amounting to 38 non-completions among 500 submitted test requests at that level.

The disproportionate growth in upper-tail latency indicates a potential capacity constraint or queuing effect as offered traffic increases. At 300 requests per hour, 487/500 requests completed (97.4%), with a P95 of 4.6 seconds; by 400 requests per hour, completion fell another 5.0 percentage points and P95 more than doubled. These are simulated stress-test outcomes, not an uptime measurement. The results therefore justify additional capacity planning and failure-mode testing rather than a claim of proven continuous availability.

7.5 Security, Auditability, and Data Interoperability Test Plan

The stated acceptance matrix is preliminary and is not a penetration-test certificate. Healthcare fraud detection and incident escalation research supports combining technical monitoring with operational escalation protocols (Idoko et al., 2024; Armah et al., 2026). Interoperability also requires semantic and organizational validation beyond network connectivity (Mukhiya & Lamo, 2021; Gowda et al., 2022).

Table 7.6. security and interface acceptance matrix.

Table 7.6 describes synthetic security and interoperability checks. The reported expected outcomes meet the listed acceptance criteria for valid access (100/100), invalid-credential rejection (100/100), and payload alteration detection (100/100). However, duplicate/replay blocking (99/100), audit-log completeness (98/100), and EHR/insurer mapping correctness (96/100) fall short of their stated criteria. Specifically, one duplicate request escaped blocking, two material actions lacked complete logs, and four mappings were incorrect within their respective 100-trial scenario sets.

These failed criteria are operationally consequential because duplicate authorizations, incomplete forensic records, and inaccurate cross-system mappings can undermine transaction integrity even where front-end performance is fast. The figures should be interpreted as prescribed synthetic test outcomes, not evidence of a certified penetration test, validated cryptographic implementation, standards compliance, or interoperability with live hospital systems. Before deployment, all failures require root-cause analysis, corrective action, and independent repeat testing against explicit acceptance thresholds.

Test scenario	Synthetic trials	expected pass	Predefined acceptance criterion
Valid authorized user	100	100 / 100	At least 99% legitimate access
Invalid credentials rejected	100	100 / 100	100% unauthorized rejections
Altered payload detected	100	100 / 100	100% integrity violations flagged
Replay / duplicate transaction blocked	100	99 / 100	100% duplicates blocked (not met)

Audit log completeness	100	98 / 100	100% material actions logged (not met)
EHR / insurer mapping checks	100	96 / 100	At least 99% correct mappings (not met)

7.6 Human–Machine Interface and Ergonomic Evaluation

The reported SUS numbers should remain explicitly labeled as modeled estimates until participants complete the standard instrument. A human-centered design and independent usability-testing process is necessary to support usability claims (Holmgren et al., 2024; Liu et al., 2024).

Table 7.7. Usability endpoints and summary values

Metric	Conventional	device	Interpretive limit
System Usability Scale (0–100)	67.5	80.0	mean; no participants tested
Task steps / authorization	8	5	modeled step count
Operator navigation actions	12	7	Scenario-defined action count
Task abandonment (%)	5.0	2.0	workflow outcome
Wrong-screen navigation (%)	8.0	3.0	task classification

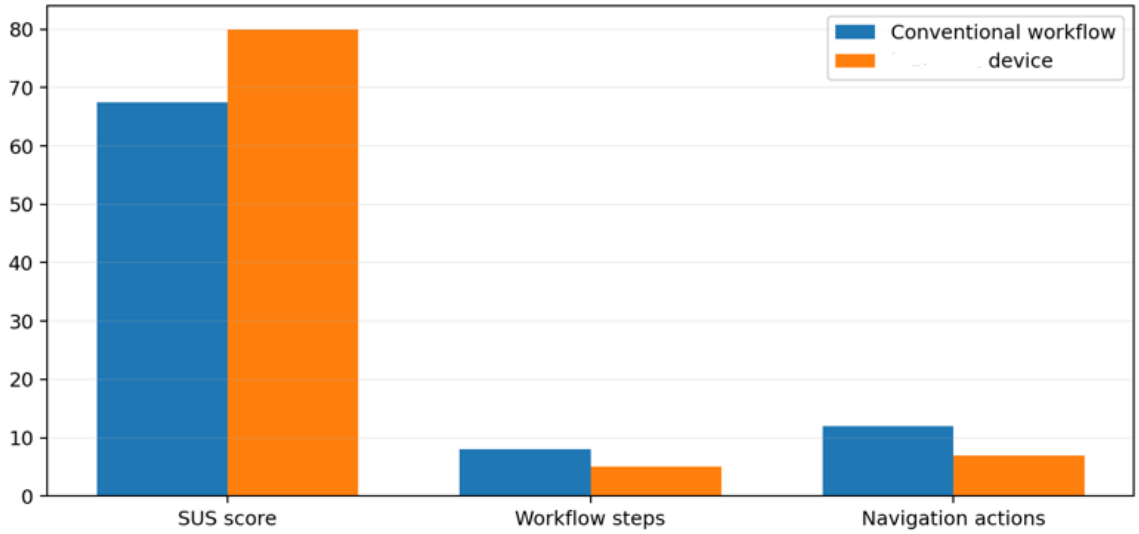


Figure 7.4. usability and interaction measures. Metrics use different units and should not be compared across categories by bar height.

The usability matrix in Table 7.7 attributes a modeled System Usability Scale (SUS) score of 80.0 to the proposed device compared with 67.5 for the conventional arrangement, a 12.5-point difference. Modeled

task steps decrease from eight to five (37.5%), navigation actions from twelve to seven (41.7%), abandonment from 5% to 2% (3 percentage points), and wrong-screen navigation from 8% to 3% (5 percentage points). Collectively, these assumptions are internally consistent with the interface strategy of reducing transitions between screens and controls.

Crucially, Table 7.7 explicitly states that no participants were tested. Therefore the SUS scores are not actual responses to a validated questionnaire administered to healthcare workers, and the stated percentages do not establish empirically observed behavior. A subsequent human-factors study should recruit representative admissions officers, pharmacists, laboratory staff, and claims personnel; use the standard SUS instrument; record independently observed task completion and misnavigation; and assess accessibility, learnability, physical comfort, and fatigue under realistic workloads.

7.7 Integrated Discussion of Findings

Taken together, the scenario-based results indicate that the consolidated device concept may deliver operational value through reduced interaction complexity, more consistent authorization decisions, and compact integration of operator-facing functions. The approximately 37% shorter modeled transaction duration aligns with reductions in assumed navigation and task steps. The 57.1% relative decline in discrepancy incidence and the increased agreement with pre-specified scenario answers point to possible improvements in procedural consistency, although neither result alone demonstrates improved clinical outcomes.

The proposed efficiency gains should be interpreted as hypotheses supported by scenario-level modeling rather than as effects demonstrated in deployed hospitals. Published EHR evaluations show that actual performance depends on interface implementation, clinical role, workflow complexity, and local configuration (Holmgren et al., 2024; Liu et al., 2024; Classen et al., 2023). The device should therefore be compared against a clearly specified baseline with identical tasks, user groups, and network conditions. The discrepancy reduction and stronger authorization agreement are technically plausible because structured data-entry pathways and verification checkpoints may reduce omission and navigation errors. Yet studies of health-IT usability demonstrate that apparent interface simplicity cannot by itself establish patient safety; real-world task observation, error classification, and harm-oriented review remain necessary (Classen et al., 2023; Holmgren et al., 2024). Digital clinical-support applications similarly require external validation before any inference about patient outcomes (Akello et al., 2026; Sankoh & Idoko, 2025).

The stress-test and acceptance-test findings impose important qualifications on this positive pattern. Response time and completion rates deteriorate considerably at higher request loads, and three specified security or interoperability criteria remain unmet. Thus, the strongest supported conclusion is not that the device is fully deployment-ready, but that its proposed workflow warrants prototype engineering and controlled validation alongside systematic risk mitigation.

This pattern is consistent with the broader security literature: transaction interfaces need end-to-end integrity assurance, authenticated access, replay protection, logging, and incident-response capability, not simply a secured physical enclosure. Healthcare-specific fraud and incident escalation studies by Idoko and collaborators provide relevant design motivations, but do not establish that the present device has implemented or passed these controls (Idoko et al., 2024; Armah et al., 2026). Related work on adversarial detection, cryptographic storage, credential attacks, and IoT infrastructure security reinforces the

requirement for layered testing (Ijiga et al., 2024; Nwatuzie et al., 2025; Ayoola et al., 2024; Okika et al., 2025). (Abbou et al., 2024; Quinn et al., 2024).

Interoperability is a distinct condition of success. The observed synthetic mapping exceptions motivate semantic validation against shared resources and terminologies, as well as explicit handling of duplicate identifiers and rejected payloads. FHIR-based integration studies document both the promise and the practical implementation challenges of device–EHR connectivity (Mukhiya & Lamo, 2021; Monteiro & Correia, 2022; Gowda et al., 2022). Broader IoT architecture comparisons are useful for system-design choices but do not replace institution-specific conformance testing (Idoko et al., 2024).

Modeled usability gains should not be reported as observed user satisfaction. Formal human-factors assessment should measure participant-reported usability, clinical task efficiency, near misses, and workload using representative operators. Evidence linking EHR design to usability and safety, together with human-centered design standards, supports this approach (Holmgren et al., 2024; Classen et al., 2023; Liu et al., 2024). Privacy-by-design and responsible use of emerging analytics should be evaluated separately from efficiency (Idoko et al., 2024; Ijiga et al., 2024).

The device's UK design registration concerns its external visual configuration. Registration should not be treated as independent proof of software efficacy, cybersecurity performance, clinical safety, or regulatory authorization. Moreover, because the current comparison is scenario-based and lacks participant-level observations, standard deviations, random assignment, external validity evidence, and confidence intervals, it is not possible to separate any device-specific advantage from assumptions built into the evaluation. Real-world comparative research will be needed to test whether the modeled benefits persist across sites, users, transaction types, and network conditions.

Accordingly, the study contributes a specified industrial-design concept and a reproducible evaluation agenda rather than a clinically validated commercial product. The broader evidence establishes why transaction interfaces warrant attention to patient safety, privacy, secure interoperability and operational reliability, but it does not independently verify the simulated numerical improvements reported here.

8. Recommendations

8.1 Prototype development and validation. Build a functional device prototype reflecting the registered physical configuration and document actual hardware, software, communication architecture, and failure handling. Repeat the four-setting evaluations using logged timestamps from operational tasks and a concurrent, clearly specified conventional-workstation comparator.

8.2 Field study and transparent reporting. Conduct a prospective, ethically reviewed multicenter usability and performance study with representative healthcare personnel. Report institutional setting, participant numbers, inclusion criteria, case mix, transaction counts, learning effects, missing records, mean and median durations, dispersion, confidence intervals, and prespecified statistical analyses. Avoid using identifiable patient information unless lawful governance and approvals are in place.

8.3 Strengthen security and audit controls. Correct the duplicate/replay rejection and audit completeness failures before live use. Apply unique transaction identifiers, idempotency checks, authenticated sessions, access controls, audit-log integrity protection, and appropriate security testing. Define a documented pass/fail policy and repeat the relevant tests until all high-priority criteria are satisfied. (Abbou et al., 2024; Quinn et al., 2024).

8.4 Improve interoperability and data quality. Investigate the four mapping failures in 100 synthetic integration trials. Implement schema validation, terminology and identifier mapping, exception queues,

reconciliation routines, and traceable interface test cases. Assess interoperability with the actual electronic health record, insurance, and payment systems of each proposed deployment site rather than assuming universal compatibility.

8.5 Establish capacity and service-level requirements. Investigate throughput bottlenecks, network delays, queue depth, timeout behavior, and recovery after failed requests. Define service-level objectives for tail latency, completion, availability, and incident recovery under realistic peak-load conditions. Perform prolonged reliability tests and maintain a manual fallback authorization pathway.

8.6 Conduct human-factors and accessibility testing. Replace modeled SUS outcomes with completed questionnaires and observed task studies. Examine seated and standing use, screen legibility, hand reach, disability access, training requirements, fatigue, and error recovery across professional groups. Revise the interface using documented user feedback.

8.7 Adopt phased implementation. Begin with a monitored pilot using synthetic or appropriately de-identified data, then advance to limited clinical-administrative use only after security, interoperability, performance, and governance criteria are met. Track transaction duration, error severity, rework, complaints, maintenance cost, and operational downtime to assess cost-effectiveness over time.

8.8 Implement standards-based identity, transaction and audit controls. Before any real patient data are processed, define role-based access, session expiry, cryptographic key handling, duplicate transaction prevention, immutable audit trails, and recovery procedures. Test authorization boundaries and API endpoints using recognized control catalogs and threat scenarios (Pascoe et al., 2024; OWASP Foundation, 2023; Armah et al., 2026).

8.9 Define interoperable deployment profiles. Publish and test structured exchange mappings, including FHIR resources, coded terminology, data provenance, versioned interface contracts, and exception handling. Benchmark the system against different EHR and payer configurations rather than assuming standards adoption alone guarantees interoperability (Mukhiya & Lamo, 2021; Monteiro & Correia, 2022; Gowda et al., 2022).

8.10 Evaluate equity, privacy and long-term governance. Include accessibility, healthcare-worker training, biometric-data minimization where applicable, privacy impact assessment, and independent algorithmic oversight before adopting intelligent features. Relevant work highlights the tradeoffs in biometric data use and ethical AI deployment (Idoko et al., 2024; Ijiga et al., 2024; Imoh & Idoko, 2023).

9. Conclusion

This study presents an integrated healthcare transaction authorization and management device concept and evaluates its potential operational benefits through comparative scenario-based results. Across four modeled service environments and 480 timed scenarios per condition, the proposed device workflow reduced average processing time from 157.50 to 99.25 seconds, equivalent to a 37.0% reduction. Discrepancy-affected scenarios declined from 35 to 15, while agreement with stipulated authorization decisions increased from 453 to 472. These results support the plausibility of a simplified, structured authorization interface as a means of reducing procedural burden.

Nevertheless, performance was sensitive to increasing simulated transaction load, with P95 response latency reaching 9.7 seconds and completion decreasing to 92.4% at 400 requests per hour. Duplicate-blocking, audit logging, and EHR/insurer mapping checks also failed the stated acceptance criteria. Usability measures were modeled without human participants and cannot be reported as observed staff

experience. Consequently, the findings should be regarded as preliminary design-evaluation evidence rather than confirmation of clinical effectiveness or readiness for unrestricted deployment.

The main contribution of the work is a testable integrated-device design and a preliminary quantitative evaluation framework covering workflow efficiency, authorization agreement, response latency, integrity controls, interoperability, and human-machine interaction. Future development should prioritize a working prototype, remediation of identified failure modes, and rigorous prospective testing across healthcare organizations. These steps are necessary to determine whether the projected gains translate into reliable, safe, accessible, and sustainable practice.

The quantitative scenarios suggest the potential for a unified terminal to simplify healthcare authorization; they do not establish field effectiveness, cybersecurity compliance or patient benefit. Priority future work is to prototype the system, implement security and interoperability controls, repeat load testing, and obtain independently observed multicenter human-factors and operational data. The emphasis on verification, auditability, and operator usability follows established medical information-system research and relevant healthcare cybersecurity studies (Gowda et al., 2022; Classen et al., 2023; Idoko et al., 2024; Armah et al., 2026).

Literature sources below are cited for contextual comparison and design guidance; they do not constitute independent validation of the simulated transaction measurements. Publisher and DOI records were used to verify bibliographic identity. Google Scholar indexing of every individual record was not independently confirmed.

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Appendix A. Original Design Claims

1. **A healthcare transaction authorization and management computer device**, comprising:
   a. an integrated visualization interface configured to present healthcare transaction information, authorization prompts, and operational feedback to healthcare personnel;
   b. a processing and control unit housed within a unified enclosure and configured to execute transaction authorization operations, manage data processing, and coordinate system functionality;
   c. a visual monitoring interface positioned on the device body and configured to display transaction status, verification outcomes, and system notifications;
   d. a user interaction interface designed to enable data entry, navigation, approval commands, and workflow management during healthcare transaction processing;
   e. a structural enclosure configured to physically integrate the visualization interface, processing components, and interaction interfaces into a single workstation-style apparatus;
   f. an ergonomic interface arrangement adapted to align the visualization and interaction regions with a user's natural viewing and reach positions; and
   g. a connectivity interface configured to provide electrical power and secure communication with external healthcare information systems and digital transaction networks.

2. The device of claim 1, wherein the visualization interface presents structured transaction data through hierarchical display layers configured to enhance readability and reduce operator error during authorization procedures.
3. The device of claim 1, wherein the processing and control unit performs real-time transaction validation including data verification, authorization decision processing, and system-state management.
4. The device of claim 1, wherein the visual monitoring interface enables continuous observation of authorization workflows and operational status without interrupting ongoing user interaction.
5. The device of claim 1, wherein the user interaction interface comprises tactile or touch-enabled control elements positioned within ergonomic reach to allow efficient execution of authorization commands.
6. The device of claim 1, wherein the structural enclosure maintains balanced mass distribution to enhance mechanical stability during operation and reduce unintended displacement of the device during user interaction.
7. The device of claim 1, wherein the ergonomic interface arrangement maintains a predefined viewing and interaction angle configured to minimize operator fatigue during prolonged usage.
8. The device of claim 1, wherein the integrated configuration reduces reliance on externally connected computing peripherals by consolidating visualization, processing, and interaction components within a single housing.
9. The device of claim 1, wherein the connectivity interface organizes power and data connections within a protected rear-facing configuration to improve operational safety and cable management.
10. The device of claim 1, wherein the visualization interface and processing unit operate concurrently to support simultaneous transaction monitoring and authorization execution.
11. The device of claim 1, wherein the enclosure geometry is configured to support deployment within hospitals, pharmacies, diagnostic centers, and healthcare administrative environments requiring compact authorization equipment.
12. The device of claim 1, wherein the integrated architecture enables standardized healthcare transaction workflows, improving consistency and reducing manual processing variability.
13. The device of claim 1, wherein system response latency between user input and authorization feedback is minimized to support real-time operational decision-making.
14. The device of claim 1, wherein the device supports adaptable operational configurations suitable for multiple healthcare transaction scenarios including patient registration, insurance verification, prescription authorization, and billing validation.
15. The device of claim 1, wherein the unified physical configuration provides an ergonomically optimized healthcare transaction platform integrating visualization, computational processing, and user interaction into a cohesive authorization and management apparatus.