同济大学

Tongji University

Jishi Building 4th Floor Navigation System: Design and Implementation Report

Course Name: Human-Computer Interaction

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1 Introduction

1.1 Project Background

The Jishi Building 4th Floor Navigation System is an intelligent navigation solution designed for the School of Computer Science and Technology. This system aims to help faculty, students, and visitors quickly locate various rooms on the 4th floor of Jishi Building, understand room purposes and personnel information, and provide convenient navigation services.

1.2 System Objectives and Functional Requirements

The overarching objective of this project was the design and implementation of a user-centric navigation system for the 4th floor of the Jishi Building, critically anchored in the principles of effective Human-Computer Interaction (HCI), with a particular emphasis on **Fluid Navigation**. The system satisfies the following core functional requirements:

- **Comprehensive Floor Overview:** The system provides users with an immediate, at-a-glance visual representation of the entire 4th-floor layout.
- **Efficient Room Selection:** Users are afforded multiple, intuitive pathways to select and subsequently view detailed information pertaining to any specific room.
- **Detailed Room Information:** Upon selection of a room, the system presents comprehensive details, including its designated purpose and a listing of associated personnel, in a clear and accessible manner.
- **Keyword Search Functionality:** A robust search mechanism is necessitated, enabling users to locate rooms or personnel by inputting queries based on room names, numerical identifiers, or personnel names.
- **Intuitive User Experience:** The navigation paradigm is inherently seamless and intuitive, consciously minimizing user effort and associated cognitive load.

2 System Design and Interface Overview

The system's design philosophy prioritizes clarity, operational efficiency, and strict adherence to HCI best practices to cultivate a fluid and intuitively navigable user experience.

2.1 Overall Architecture and File Structure

The system is implemented using front-end web technologies including HTML for page structure, CSS for styling, JavaScript for interactive logic, and JSON files for data storage. The project follows a modular structure with index.html as the main page, style.css for styling, data.js for room information storage, app.js for application logic, and images in the `images/` directory for the visual floor map.

The architectural design emphasizes separation of concerns and maintainability. The HTML structure provides semantic markup with clear content hierarchy, utilizing modern HTML5 elements like `header`, `nav`, `main`, and `aside` to establish logical document structure. The CSS implementation employs responsive design principles with flexbox layouts, CSS Grid for image galleries, and media queries for cross-device compatibility. JavaScript modules handle distinct responsibilities–`data.js` contains all room in-

formation in a structured JSON format, while `app.js` manages user interactions, DOM manipulation, and navigation logic.

```
lab4/
|-- index.html            # Main page file
|-- css/
|   +-- style.css         # Style file
|-- js/
|   |-- data.js           # Data file
|   +-- app.js            # Application logic
+-- images/
    +-- rooms.png         # All room images stored
```

Listing 1: Project File Structure

2.2 Homepage Interface Design

The homepage(visualized in Figure 1) presents a clean and intuitive interface that immediately communicates the system's purpose through careful visual hierarchy and information architecture. The design follows established web conventions while incorporating custom elements that support the navigation functionality. The central floor plan serves as both a visual anchor and the primary interaction surface, surrounded by supporting navigation elements that enhance rather than compete with the spatial interface.

The color scheme utilizes a professional palette with distinct colors for different room categories—blue for experimental areas, green for teaching spaces, and red for administrative offices. This color coding extends throughout the interface, providing consistent visual cues that reinforce the spatial organization. Typography choices prioritize readability across devices while maintaining visual hierarchy through size, weight, and spacing variations.

Figure 1: System Homepage Interface

2.3 Sidebar Navigation System

The collapsible sidebar menu(visualized in Figure 2)represents a sophisticated implementation of hierarchical navigation principles, providing structured access to all rooms

through logical categorization while maintaining flexibility for different user preferences and device constraints. The menu system employs progressive disclosure techniques, allowing users to expand room categories on demand while keeping the interface uncluttered.

Each menu category includes visual indicators for expansion state and contains room entries that combine identification numbers with functional descriptions. This dual-labeling approach accommodates both spatial navigation (users who think in terms of room numbers) and functional navigation (users who seek specific services or purposes). The sidebar's responsive behavior demonstrates advanced CSS techniques, smoothly transitioning between visible and hidden states while maintaining proper spacing and alignment.

Figure 2: Interface with Expanded Sidebar Menu

2.4 Interactive Room Selection and Information Display

When users click on room markers or select from the menu, the system provides immediate visual feedback and detailed information display. The selected room is highlighted on the map(visualized in Figure: 3) while the information panel updates to show comprehensive room details including area designation, functional description, and personnel information(visualized in Figure: 4). This interaction demonstrates the system's context preservation principle by maintaining the spatial reference while revealing progressive details.

The system ensures consistent visual feedback regardless of the selection method employed. Whether users access rooms through the hierarchical sidebar menu or by directly clicking on map markers, the corresponding marker receives distinctive highlighting that clearly indicates the currently selected location. This bi-directional synchronization between navigation methods reinforces spatial awareness and prevents user disorientation during exploration.

Figure 3: Marker Highlighting for Different Access Methods

Figure 4: Interactive Room Selection and Information Display

The information panel implements progressive disclosure principles, initially showing basic room identification and purpose, then revealing detailed personnel information, descriptions, and visual materials based on user interaction. The panel's scroll behavior and content organization facilitate easy reading while accommodating varying amounts of information across different rooms.

2.5 Search Functionality Demonstration

The search implementation represents a comprehensive approach to information retrieval that supports multiple query types and provides intelligent result organization. The system processes queries across room numbers, names, purposes, personnel names, and functional descriptions, utilizing fuzzy matching techniques to accommodate variations in user input and terminology.

Real-time result presentation includes result categorization, duplicate elimination, and relevance ranking to help users quickly identify the most appropriate matches. The search interface adapts to mobile contexts by providing larger touch targets and optimized result display formats that work effectively on smaller screens.

Figure 5: Search Functionality Demonstration

3 Fluid Navigation Implementation

3.1 Core Principles and User Position Awareness

Fluid Navigation focuses on enabling smooth, efficient user movement through interfaces by addressing two key needs: *spatial awareness* and *efficient target access*. Our system implements these principles through coordinated visual feedback mechanisms that maintain user context across all interface elements.

The feedback system ensures users understand their current position through map marker highlighting, sidebar menu activation, and information panel updates. This comprehensive approach prevents disorientation during navigation transitions and maintains spatial context throughout the user journey.

3.2 Navigation Structures and Content Organization

Our implementation integrates multiple navigation approaches including hierarchical menus, visual spatial interfaces, and direct search access.

The hierarchical sidebar follows broad, shallow tree principles, organizing rooms by functional categories that align with user mental models and task requirements. The visual floor plan interface functions as a graphical grid, enabling spatial recognition-based navigation that complements systematic browsing approaches. This dual approach accommodates different user preferences while maintaining consistent interaction patterns across all navigation methods.

3.3 Expert Features and Responsive Design

The system provides multiple interaction pathways to accommodate varying user expertise levels and device capabilities. Expert users benefit from keyboard shortcuts and gesture support, while novice users can rely on traditional point-and-click interactions. Touch device support includes comprehensive gesture integration with tap, swipe, and pinch interactions.

Responsive design implementation automatically adapts to screen constraints through collapsible navigation panels, optimized touch targets, and contextual interface adjustments. Mobile optimization includes automatic panel closure after selections and enhanced search prominence to accommodate touch-based input preferences.

3.4 Progressive Disclosure and Information Architecture

The system implements sophisticated progressive disclosure that reveals information based on user actions and contexts. Default states provide welcoming overviews without overwhelming detail, while user selections trigger carefully sequenced information revelation that maintains relevance and prevents cognitive overload.

Search functionality demonstrates advanced progressive disclosure through real-time filtering and result categorization, enabling users to quickly identify optimal navigation pathways to their objectives while maintaining spatial context throughout the exploration process.

4 System Implementation and Technical Architecture

4.1 Data Management and Interactive Systems

The system implements a comprehensive data management architecture using JSON-based structures that accommodate multilingual content, spatial positioning coordinates, and extensive metadata. Dynamic marker generation utilizes sophisticated positioning algorithms that maintain spatial accuracy through coordinate transformation calculations across different screen configurations and zoom levels.

The technical implementation prioritizes smooth user interactions through optimized rendering pipelines and efficient event handling systems. Search functionality utilizes efficient indexing algorithms that provide real-time feedback without performance degradation, while map interaction systems support multiple input methods including mouse-based pointing, touch gestures, and keyboard navigation.

4.2 Performance and Compatibility

The system architecture emphasizes performance optimization through strategic resource loading and intelligent caching mechanisms. Cross-platform compatibility is achieved through progressive enhancement techniques that provide core functionality across all browsers while enhancing the experience on more capable platforms. The responsive design implementation utilizes flexible layout systems that maintain usability across desktop, tablet, and mobile devices.

5 Conclusion

The Jishi Building 4th Floor Navigation System successfully demonstrates the practical application of **Fluid Navigation principles** through comprehensive interface design and technical implementation. The system provides intuitive navigation experiences that accommodate diverse user needs while maintaining spatial context and minimizing cognitive load. Through careful integration of multiple navigation approaches, responsive design principles, and progressive disclosure techniques, the system achieves efficient and accessible indoor navigation that serves the School of Computer Science and Technology community effectively across various devices and usage contexts.