TU856/3
UNIVERSAL DESIGN AND ASSISTIVE ICT

ASSIGNMENT 1
WAYFINDING APP – ENHANCING ACCESSIBILITY

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1. AUDIT OF AN EXISTING WAYFINDING APP FOR UNIVERSAL DESIGN CONFORMANCE

Selected App: Google Maps

Overview

Google Maps is one of the most widely used navigation apps, offering real-time navigation, route planning, and location-based services. It provides various accessibility features, including voice guidance, screen reader support, and wheelchair-accessible routes. However, despite these efforts, it does not fully conform to the Seven Principles of Universal Design (UD). This audit evaluates its strengths, weaknesses, and potential improvements to enhance accessibility.

Analysis Based on the Seven Principles of Universal Design

1. **Equitable Use**
   - **Strengths:**
     - Supports voice navigation, screen reader compatibility, and wheelchair-accessible routes.
     - Works across multiple devices and platforms, making it widely available.
   - **Weaknesses:**
     - Street View lacks audio descriptions, limiting its usefulness for visually impaired users.
     - The complex interface may be overwhelming for users with cognitive disabilities.
   - **Suggested Improvement:**
     - Implement audio-based descriptions for Street View to improve accessibility for visually impaired users.
     - Introduce a simplified mode with a minimal UI for users with cognitive impairments.
2. **Flexibility in Use**
   - **Strengths:**
     - Supports multiple input methods, including touch, voice commands, and keyboard navigation, with multiple route options.
   - **Weaknesses:**
     - Limited customization for accessibility settings; inconsistent voice command responsiveness.
   - **Suggested Improvement:**
     - Provide adjustable voice command sensitivity and customizable accessibility settings.
3. **Simple and Intuitive Use**
   - **Strengths:**
     - Features an intuitive search function and step-by-step navigation guidance.
   - **Weaknesses:**
     - Complex interface with multiple menus can be difficult for users with cognitive impairments.
     - Some important accessibility features are not easily discoverable.

- **Suggested Improvement:**
  - Introduce a “Simplified UI Mode” that focuses on essential functions.
  - Provide clear onboarding tutorials for first-time users to navigate the app easily.

4. **Perceptible Information**
   - **Strengths:**
     - Integrates text-to-speech, haptic feedback, and visual cues for users with visual impairments.
   - **Weaknesses:**
     - Limited high-contrast options, reducing visibility for low-vision users.
     - Colour-coded elements are not optimized for colourblind users.
   - **Suggested Improvement:**
     - Add a high-contrast mode for better readability.
     - Introduce colourblind-friendly indicators, such as textured patterns alongside colours.
5. **Tolerance for Error**
   - **Strengths:**
     - Provides automatic rerouting when users take a wrong turn.
     - Offers estimated arrival times to help users adjust plans in real-time.
   - **Weaknesses:**
     - No "Undo" function for accidental route selections.
     - No error correction suggestions for mistyped locations.
   - **Suggested Improvement:**
     - Implement an "Undo" button to revert accidental changes.
     - Introduce AI-powered error correction to suggest intended locations.
6. **Low Physical Effort**
   - **Strengths:**
     - Supports voice commands for hands-free navigation.
   - **Weaknesses:**
     - Small UI elements make selection difficult for motor-impaired users.
   - **Suggested Improvement:**
     - Introduce gesture-based controls for better accessibility which allows users to adjust button sizes for easier selection.
7. **Size and Space for Approach and Use**
   - **Strengths:**
     - Adapts to different screen sizes and orientations (landscape/portrait).
   - **Weaknesses:**
     - Some controls remain too small or closely spaced, making it harder for users with motor impairments.
   - **Suggested Improvement:**
     - Larger, more widely spaced buttons to improve touch accuracy for users with dexterity limitations.

Summary of Audit Findings

Google Maps offers accessibility features but does not fully align with Universal Design. Improving interface simplicity, contrast settings, and gesture-based controls would enhance usability. Adding AI-powered error correction, customizable accessibility settings, and audio descriptions for visually impaired users would further support a diverse range of needs.

2. PROPOSED UNIVERSAL DESIGN ENHANCEMENTS FOR THE WAYFINDING APP

Overview of the Enhanced Design

Following the audit of Google Maps, this enhanced wayfinding app is designed to fully align with the Seven Principles of Universal Design (UD). The goal is to create an accessible, user-friendly navigation solution that accommodates individuals with visual, motor, auditory, and cognitive impairments.

This improved app will include:

- AI-powered voice navigation
- Customizable accessibility settings
- Multi-sensory feedback (haptic, audio, and visual cues)
- Simplified, user-friendly interface
- Error prevention and recovery mechanisms

Key Features of the Enhanced App

1. Customizable Interface

To improve accessibility for users with visual, cognitive, and reading disabilities, the app will offer:

- High-contrast mode for low-vision users.
- Dyslexia-friendly font options (e.g., OpenDyslexic).
- Adjustable text sizes (small, medium, large, extra-large).
- "Simplified Mode" to remove complex UI elements for users with cognitive disabilities.

Reasoning: Providing personalization options improves usability for different disability groups by reducing cognitive strain and enhancing readability.

2. Advanced Voice Navigation

To enhance usability for blind and visually impaired users, this app will integrate:

- AI-powered voice assistant that supports natural language commands.
- Contextual voice descriptions (e.g., “Turn left in 10 meters. A café will be on your right.”).
- Speech-to-text input for users unable to type.

Reasoning: Google Maps’ voice feedback lacks detailed descriptions. By integrating AI-driven voice guidance, blind users can navigate more independently and confidently.

3. Multi-Sensory Feedback

To improve wayfinding accuracy, the app will provide tactile and auditory cues:

- Haptic vibrations at key navigation points for deafblind users.
- Colour-coded directional cues optimized for colourblind users.
- 3D spatial sound guidance to help users with auditory impairments navigate.

Reasoning: Users rely on multiple senses for navigation. Haptic feedback is critical for deafblind users, while colourblind-friendly indicators improve visibility.

4. Enhanced Wheelchair Accessibility

For users with mobility impairments, the app will feature:

- Real-time updates on wheelchair-accessible routes.
- Live notifications of barriers (e.g., stairs, road construction, broken elevators).
- Step-free navigation routes with detailed accessibility information.

Reasoning: Google Maps lacks real-time updates on accessibility obstacles. This enhancement ensures wheelchair users can avoid unexpected barriers.

5. Error Prevention and Recovery

To prevent user frustration, the app will provide:

- "Undo" button for accidental route changes.
- Auto-save for frequent destinations to prevent repeated searches.
- Clear error messages with suggested corrections.

Reasoning: An "Undo" feature is crucial to prevent navigation errors, and auto-save prevents frustration when re-entering destinations.

6. Low-Effort Navigation

For users with motor impairments, the app will offer:

- One-tap navigation for users with dexterity challenges.
- Gesture-based controls (e.g., swiping instead of small button taps).
- Compatibility with eye-tracking and external switch devices.

Reasoning: Larger buttons, swipe gestures, and hands-free controls improve accessibility for motor-impaired users.

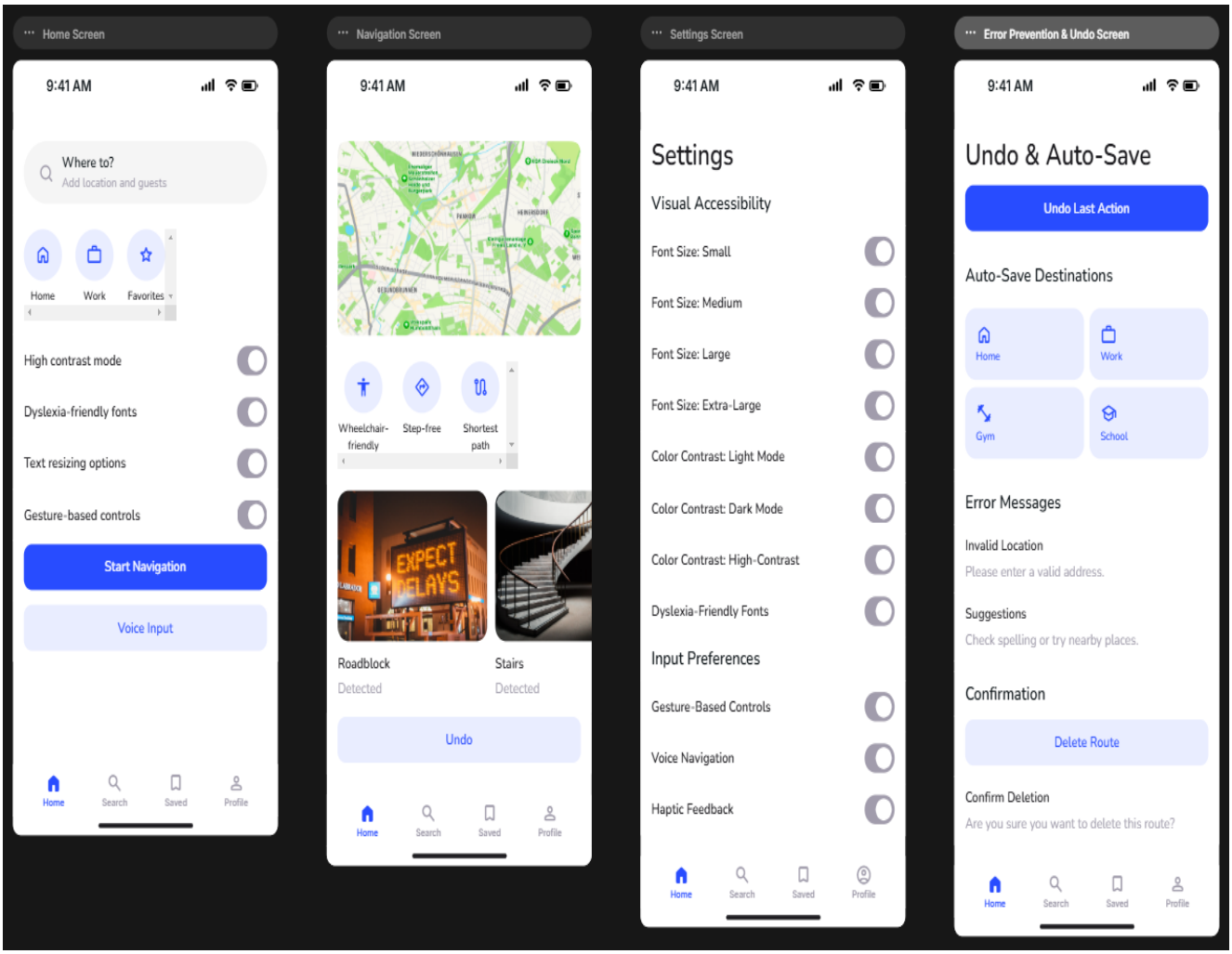
Wireframes of the Enhanced Wayfinding App

The following wireframes illustrate the user interface and accessibility enhancements incorporated into the proposed Universal Design-compliant Wayfinding App. These designs integrate key accessibility features, aligning with the Seven Principles of Universal Design to ensure usability for individuals with diverse abilities.

Key Accessibility Enhancements in the Wireframes:

- **Customizable Interface:** High contrast mode, dyslexia-friendly fonts, and adjustable text sizes.
- **Error Prevention & Undo:** "Undo" and "Auto-Save Destinations" features for easy error recovery.
- **Simplified Navigation:** Minimalistic UI with clear, large buttons to accommodate cognitive impairments.
- **Multi-Sensory Feedback:** Roadblock alerts, step-free navigation, auditory cues, and haptic feedback.
- **Gesture-Based Controls:** Options for voice input and alternative touch gestures for users with motor impairments.

These wireframes demonstrate how accessibility features improve the overall navigation experience, ensuring an inclusive wayfinding solution for all users.



3. JUSTIFICATION OF DESIGN CHOICES

The enhanced wayfinding app is designed to fully align with the Seven Principles of Universal Design (UD), ensuring accessibility for users with visual, auditory, cognitive, and motor impairments. Below is a justification of how each design choice improves inclusivity and usability.

1. Equitable Use

Principle Explanation: The app should be usable by all people, regardless of their abilities, without requiring adaptation.

Implementation in the Enhanced Wayfinding App:

- Multiple input methods (voice, touch, gestures) support users with motor impairments.
- Customizable UI allows users to adjust contrast, text size, and fonts for better accessibility.
- Real-time wheelchair-friendly routes cater to users with mobility impairments.

Justification: These features ensure equal access by accommodating diverse needs without requiring alternative versions of the app.

2. Flexibility in Use

Principle Explanation: The app should accommodate diverse user preferences and needs.

Implementation in the Enhanced Wayfinding App:

- AI-powered voice navigation allows users to control the app without requiring fine motor skills.
- Multiple route options help users choose routes based on mobility needs (wheelchair-accessible, step-free).
- Customizable display settings (e.g., high contrast mode, simplified mode) provide personalized usability.

Justification: Adaptable interaction methods ensure users can navigate comfortably, regardless of their physical or cognitive abilities.

3. Simple and Intuitive Use

Principle Explanation: The app should be easy to understand and operate, regardless of the user's experience or cognitive ability.

Implementation in the Enhanced Wayfinding App:

- Simplified UI mode removes unnecessary elements, reducing cognitive overload.
- Step-by-step navigation instructions provide clear, structured guidance.
- Guided onboarding tutorials help first-time users understand app functionality.

Justification: A clutter-free interface, guided navigation, and structured onboarding ensure accessibility for users with cognitive impairments.

4. Perceptible Information

Principle Explanation: The app should present information in multiple formats to support diverse sensory abilities.

Implementation in the Enhanced Wayfinding App:

- Voice navigation, text prompts, and haptic feedback provide auditory, visual, and tactile directions.
- Colour-coded directional cues optimized for colourblind users.
- High-contrast settings improve visibility for low-vision users.

Justification: Multi-sensory feedback ensures that users with vision, hearing, or cognitive impairments can access and process navigation information effectively.

5. Tolerance for Error

Principle Explanation: The app should minimize user errors and offer easy recovery options.

Implementation in the Enhanced Wayfinding App:

- "Undo" button prevents frustration from accidental inputs.
- Auto-save feature stores frequently used destinations to avoid unnecessary re-entry.
- Clear error messages suggest corrections for mistyped locations.

Justification: These features prevent mistakes and reduce frustration, making the app more user-friendly and stress-free.

6. Low Physical Effort

Principle Explanation: The app should be efficient to use, requiring minimal physical effort.

Implementation in the Enhanced Wayfinding App:

- One-tap navigation reduces effort for users with dexterity challenges.
- Gesture-based controls allow users to swipe rather than tap small buttons.
- Hands-free voice control supports users with severe motor impairments.

Justification: These features reduce strain and make the app accessible for users with limited mobility.

7. Size and Space for Approach and Use

Principle Explanation: The app should provide ample space and flexibility for all users, including those using assistive technology.

Implementation in the Enhanced Wayfinding App:

- Larger buttons and UI elements reduce the need for precise tapping.
- Adjustable text size and spacing improve readability for low-vision users.
- Supports portrait and landscape modes for greater flexibility.

Justification: A responsive and adaptable UI layout ensures users with dexterity challenges or visual impairments can comfortably use the app.

4. REFERENCES AND RESOURCES

To strengthen the credibility of the proposed enhancements, the following references support the design decisions and accessibility improvements:

- **Web Content Accessibility Guidelines (WCAG) 2.1 – W3C**
  https://www.w3.org/WAI/WCAG21/quickref/
- **Centre for Excellence in Universal Design**
  http://universaldesign.ie/
- **Google Maps Accessibility Features**
  https://support.google.com/maps/answer/6396990?hl=en
- **NCSU Universal Design Principles Poster**
  https://design.ncsu.edu/wp-content/uploads/2022/11/principles-of-universal-design.pdf
- **SavyAssist – Accessible Travel Apps for Disabled Travelers**
  https://savyassist.com/a-comprehensive-guide-to-accessible-travel-apps-for-disabled-travelers