Pitch

This project's system is designed to empower visually impaired individuals by enhancing their ability to perceive and interact with their environment. By employing advanced sensor technology, this project translates spatial layouts into intuitive soundscapes, offers real-time auditory feedback on obstacles, and provides detailed cues about objects within reach. This system is an enabler for the visually impaired to navigate, interact, and engage confidently in varied spaces, facilitating independence and enriching their quality of life.

User Persona

Name: John Taylor

Age: 29

Occupation: Customer Service Representative

Location: Urban area, living independently

Photo Description: A man in his late 20s, wearing smart casual clothes and dark sunglasses, holds a white cane and has a pair of headphones around his neck.

Quote: "I seek to navigate the world as freely as anyone else, to interact with it on my terms, without being held back by my visual impairment."

Summary: John is a visually impaired individual living in a bustling city. He is tech-savvy and independent, relying on public transportation and his senses to go about his daily routine. John is always on the lookout for technologies that can make his life easier and allow him to interact more seamlessly with his surroundings.

Narrative: John has been visually impaired since birth, but he has never let this define his capabilities. He works as a customer service representative and is known for his attention to detail and exceptional problem-solving skills. Despite his proficiency with traditional aids like the white cane, John finds them limiting, especially when navigating crowded or unfamiliar environments. He is an early adopter of technology, using various apps to assist with reading and navigation.

Goals:

- To move safely and confidently in social and work settings
- To identify objects and obstacles independently
- To receive real-time, non-intrusive feedback about his environment

Needs:

- A system that can convey detailed information about his surroundings
- Auditory feedback that is pleasant, non-distracting, and provides spatial orientation

- Technology that can adapt to different environments, from quiet offices to noisy streets.

Frustrations:

- Traditional aids that provide limited information
- Current technologies that fail to offer detailed or nuanced feedback
- Systems that require extensive training or are not intuitive to use

Key Differentiators:

- John represents users who are not just looking for basic navigation tools but also desire a more enriched interaction with their environment
- Unlike users who may be resistant to new technolgy, John is eager to integrate advanced solutions into his life
- He requires a system that can distinguish between various types of obstacles, including those above ground level, which traditional aids cannot detect

Content Preferences:

- John prefers audio cues that are informative but not overwhelming
- He values feedback that is context-sensitive and adjusts to ambient noise levels
- He is interested in customizable settings that allow him to tailor feedback to his preferences and the demands of different environments

Scenario 1: Navigating Through a Crowded Street

Scenario Description: John is attempting to navigate through a crowded street to reach a local café. The auditory feedback system provides real-time audio cues about the proximity, direction and nature of obstacles. The system also alerts John to the presence of streeet signs, pedestrian crossings, and potential hazards like construction work ahead.

Data Conveyed via Audio:

- Proximity warnings: The system uses changes in pitch to indicate the distance to obstacles; a higher pitch means closer proximity
- Directional cues: Stereophonic sound indicates the direction of the path or obstacles (e.g., sound in the left ear means turn left)
- Environmental context: Sounds of a bustling street are processed to highlight important noises like traffic signals and crosswalk beeps
- Social navigation: The system reduces ambient noise and enhances human voices to help John identify when someone is approaching or when they are being spoken to

User Perception and interpretation:

- John perceives a high-pitched tone increasing in frequency and understands there is an obstacle close by that requires immediate attention

- A soft, low tone in the right earbud suggests a clear path to the right
- A unique chime indicates the café’s door is directly ahead

Inputs and Input Modalities:

- John can use voice commands to request specific information (“direction to the nearest crosswalk”)
- Gestures or taps on the device can signal the system to repeat the last instruction or provide more detailed descriptions

Scenario 2: Locating Items in a Supermarket

Scenario Description: John is shopping for groceries. The system assits John in locating specific items on shelves and provides information about products, such as their prices and descriptions.

Data Conveyed via Audio:

- Object identification: The system uses image recognition to identify items and gives a brief audio description
- Spatial layout: Converts the aisle layout into a sound map, helping John understand the arrangement of the sections
- Special offers: Alerts John to discounts or promotions nearby using a distinct melody or series of tones

User Perception and Interpretation:

- John hears a description of the item’s location relative to their current position (e.g., “rice is on the shelf to your left, two meters ahead”)
- A special offer is indicated by a unique jingle followed by an audio message detailing the offer

Inputs and Input Modalities:

- John can request to locate a specific item using voice commands
- By pressing a button on the device, John can tag favorite items for easier location in the future

Scenario 3: Using Public Transport

Scenario Description: John is at a train station trying to find the correct platform for their train. The system provides information about train schedules, platform changes, and guides John through the station with audio cues.

Data Conveyed via Audio:

- Timetable updates: An automated voice announces train times and any delays or cancellations
- Directional guidance: Audio cues lead John to the correct platform and inform them about elevators, stairs, and turnstiles
- Boarding assistance: The system emits a distinct sound when John is in front of the train door, helping them to board the train safely

User Perception and Interpretation:

- John hears a friendly voice giving them the countdown until their train's arrival
- A series of beeps increases in speed as John approaches the correct platform
- A unique tone plays when it's time to board, and the sound moves from one ear to the other, indicating the door's direction

Inputs and Input Modalities:

- John uses a braille keypad attached to the device to input the desired train line or destination
- Swiping on a touch-sensitive area of the device can help John request the repetition of the last message or ask for help from station staff

Sensor Data Description

Evenets:

1. **ObstacleDetected**

- Location: (relative position from the user)
- Priority: 1 (immediate action required) to 3 (awareness only)
- Type: "Static" (e.g., wall, post) / "Dynamic" (e.g., moving person, pet)
- Height: (ground level, waist level, head level)
- MovementDirection: (if dynamic: towards user, away from user; static)
- Tag: (specific identification, e.g., "Fire Hydrant")
- Flag: True (for objects detected on the path), False (for no longer in path)

2. **NavigationAid**

- Destination: (name or type of destination, e.g., "Café", "Office")
- CurrentLocation: (user's current location)

- NextAction: (turn left, straight, elevator up, etc.)
- DistanceToNext: (meters)
- ETA: (estimated time of arrival)
- Priority: 1 to 3

3. **ItemLocalization**

- Item: (name of the item, e.g., “Keys”, “Phone”, “Entrance”)
- Location: (relative position from the user)
- Distance: (meters from the user)
- Priority: 1 to 3 (based on user’s urgency setting for the item)

4. **PublicTransportUpdate**

- TransportType: (Bus, Train, etc.)
- Status: “Arriving”, “Delayed”, “Cancelled”
- Time: (in seconds. ETA for “Arriving” status, delayed time for “Delayed” status)
- Platform/Gate: (relevant number or identifier)

5. **SocialInteraction**

- InteractionType: “Handshake”, “Greeting” (someone waving a hand), “Question” (someone raising hands to ask)
- Direction: front, left, right (where the sound or gesture came from)
- Distance: (how far the sound source or the gesture is)
- Tag: “KnownPerson”, “Stranger”, “Crowd”
- Flag: True (for initiating interaction), False (for ending interaction)
- Priority: 1 to 3

6. **EnvironmentalConditions**

- Weather: “Sunny”, “Raining”, “Cloudy”, “Windy”
- LightCondition: “Bright”, “Normal”, “Dim”, “Dark”
- IndoorStatus: True (for indoor), False (for outdoor)
- CameraSensorAccuracy: 1 to 3
- SoundSensorAccuracy: 1 to 3

7. **NotificationSetting**

- UserPreference: “MinimalInterruptions”, “Medium”, “DetailedGuidance”
- TargetEvents: ObstacleDetected, NavigationAid, ItemLocalization, PublicTransportUpdate, SocialInteraction

8. **DeviceStatus**

- BatteryLevel: 1 to 10
- ConnectivityStatus: 1 to 10

User Experience

For the user experience of the simulator, the focus is on simplicity, intutiveness, and accessibility, particularly catering to the needs of visually impaired users and their non-expert assistants (e.g., family members of the user). The device is designed without screens, emphasizing tactile controls and auditory feedback. It connects to a PC for more detailed settings adjustments, allowing visually non-impaired assistants to help configure the device. This setup ensures that both users and their assistants can interact with the device comfortably and efficiently.

User Interface Elements for Visually Impaired Users

Buttons: The device includes several tactile buttons, each serving a distinct function such as turning the device on/off, initiating specific commands (e.g., “Where am I?”, “Repeat last instruction”), or sending an alert for assistance. Two of these buttons are allocated for preset configurations that can be switched instantly for different environments. These buttons have unique shapes or textures to be easily distinguishable by touch.

Scrollers: Two scrollers are incorporated for volume adjustment and navigating through options or settings. One scroller adjust the overall volu,e. while the second allows users to cycle through different types of auditory feedback (e.g., navigation aid, environmental alerts, social interactions) for customized volume settings.

Voice Commands: Users can interact with the device using voice commands for hands-free operation, requestisng information, or changing settings.

Haptic Feedback: For key actions or alerts, the device provides hapctic feedback to confirm user inputs or signal important notifications.

User Interface when PC connected

Visual Indicators for Audio settings: The PC interface includes visual representations of sound settings, including sliders for volumes and visual cues for different sound types. This visual feedback help assistants understand the changes they are making to the auditory environment of the visually impaired user.

Preset Configurations: To simplify customization, the interface offers preset configurations tailored to common environments (e.g., home, outdoors, crowded spaces). Assistants can select a present and further customize it as needed.

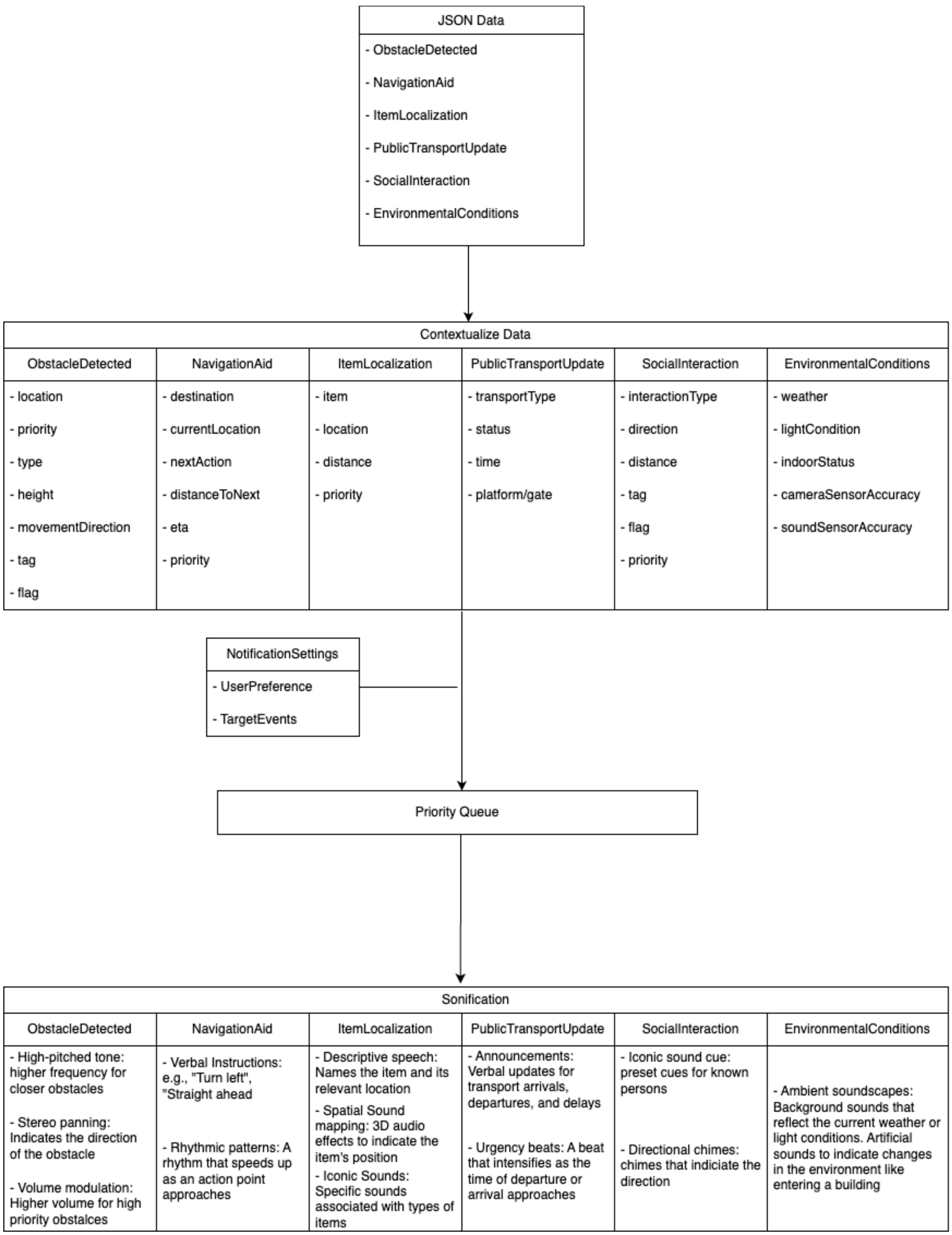
Interaction Between UI Elements and Sensor Data

Dynamic Volume Adjustment: Based on the priority of sensor-detected events, the device automatically adjust the volume of auditory feedback. For instance, high-priority alerts are conveyed at a higher volume, ensuring they are not missed.

Adaptive Feedbakck: Depending on the user’s current activity or environment, identified through sensor inputs, the device adapts its feedback. For example, in quieter settings, the volume of feedback is lowered to prevent disturbance, while in noisy environments, the clarity of auditory cues is enhanced.

Event-Specific Sound cues: The device employs distinct sound cues (e.g., earcons, speech synthesis) for different types of events, informed by the sensor data stream. This differentiation helps user quickly understand the nature of the information being conveyed without needing explicit verbal descriptions.

Software Architecture



Work plan

Week 1

- Develop sonification engine
- Mock-up sound design

Week 2

- Create Json mock data
- Build logic to contextualize the Json data
- Add UI to interact

Week 3

- Connect contextualization logic and sonification engine
- Finalize UI
- Create and submit PD#5 evaluation plan

Week 4

- Schedule meeting with evaluation participants
- Complete evaluation
- Submit PD#4 Simulator Implementation

Week 5

- Analyze the data from the evaluation
- Write evaluation results

Week 6

- Submit PD#6 Evaluation Results