NaviSense: Project Description

Honors Academy – Empowerment for Health and Wellbeing

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1 Introduction

1.1 Purpose

People with visual impairments often face significant challenges navigating complex indoor environments like hospitals, universities, or municipal buildings. These spaces are typically designed with sighted users in mind, heavily relying on visual cues such as signs, colors, and symbols to guide people to their destinations. As a result, individuals with limited or no sight often experience anxiety, dependence on others, and reduced autonomy when moving through public spaces. The NaviSense project aims to restore this autonomy by designing an intuitive and convenient indoor navigation solution tailored to the needs and sensory preferences of people with visual impairments.

1.2 Scope

The final NaviSense product should deliver accurate, real-time navigation assistance in indoor environments. It should fit seamlessly alongside existing aids—most crucially the white cane and smartphone—rather than replacing them.

The system must:

- Provide clear, intuitive directional feedback using haptic or spatial audio cues.
- Respect the user's natural sensory environment (e.g., not block environmental sounds).
- Support orientation and obstacle awareness in real-world, dynamic environments.
- Integrate easily into public spaces such as hospitals and campuses without requiring excessive infrastructure.

It is not within scope for the system to manage outdoor navigation, perform full obstacle avoidance independently, or require costly infrastructure like large beacon networks. Instead, NaviSense focuses on user experience, feedback design, and adaptability to different buildings and users.

2 General Description

2.1 Product Perspective

NaviSense will act as a bridge between the digital and physical world, translating spatial information into sensory feedback users can understand and act upon confidently. The envisioned product is a portable, user-centered system that can take different hardware forms (e.g., smartphone interface, wearable module, or haptic attachment) but follows the same design logic: empower users to move independently indoors.

The core product will:

- Use real-time localization and mapping technologies (e.g., computer vision, LiDAR, or sensor fusion) to interpret the environment.

- Deliver navigational feedback through customizable modes—vibration intensity, spatial audio direction, or concise audio instructions.
- Integrate into a "digital twin" of the physical environment, allowing testing, simulation, and iterative improvement of feedback methods before physical deployment.

The design philosophy emphasizes **simplicity, discretion, and intuitiveness**. The system should avoid cognitive overload, require minimal setup, and allow users to focus on moving rather than managing technology. Rather than relying on external devices or staff intervention, NaviSense will make users self-reliant through immediate, context-aware feedback.

2.2 User

The primary users are individuals with partial or total visual impairments who navigate public indoor spaces independently or semi-independently. Research and interviews with over twenty users have identified several key user characteristics:

- Most rely primarily on white canes (85%) and smartphones for secondary assistance.
- Users strongly prefer feedback via vibration (50%) or subtle audio cues (40%) that do not interfere with environmental awareness.
- Autonomy and safety are central emotional needs; any sense of dependence or cognitive burden significantly reduces usability.
- Users value discretion—devices should not visually "stand out" or require conspicuous behavior.

Secondary stakeholders include hospitals, municipalities, and public institutions looking to improve accessibility without incurring excessive installation or maintenance costs. For them, NaviSense represents a scalable, service-oriented solution rather than an isolated product - one that integrates accessibility into the building ecosystem seamlessly.

Summary

In essence, NaviSense envisions an adaptive, feedback-driven indoor navigation ecosystem that restores independence to people with visual impairments. By merging spatial computing technologies with human-centered design, it seeks to make complex environments navigable, intuitive, and inclusive—transforming "getting lost" into confident, autonomous movement.