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# **Team Visionaries**

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## **Theia Blind Indoor Navigation System Vision**

**Version 1.1**

# Revision History

Date	Version	Description	Author
04/14/24	1.0	Initial Document	Bakr Alkayal Ann Rogers Sebastian Deleon Kaiden Gallardo
04/28/24	1.1	Finalized Document	Bakr Alkayal Ann Rogers Sebastian Deleon Kaiden Gallardo

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## 1. Introduction

### 1.1. Purpose

The purpose of this document is to collect, analyze, and define high-level needs and features of the Theia Blind Indoor Navigation System. It focuses on the capabilities needed by the stakeholders, and the target users, and why these needs exist. The details of how the Theia Blind Indoor Navigation System fulfills these needs are detailed in the use case and supplementary specifications.

### 1.2. Scope

This Vision Document applies to the Theia Blind Indoor Navigation System, which will be developed by Team Visionaries. This system will allow visually impaired users to safely navigate indoor environments, such as schools, offices, and public buildings. Utilizing advanced smartphone sensors such as GPS and Cameras, Theia provides real-time audio guidance, obstacle detection, and route optimization to assist users in reaching their destinations safely and efficiently.

## 2. Positioning

### 2.1. Business Opportunity

Safety is one of the most important human needs a human must possess in order to live more comfortably. One aspect of safety includes safely navigating the world humans live in. For many people, this is as simple as just using their eyes to detect obstacles in their environment and moving their bodies accordingly. However, people with visual impairment disabilities do not have such an option to ensure their safety. They will have to use another method of detection and avoidance in order to fulfill their basic human need for safety. That is where Theia Blind Indoor Navigation System comes in. This system will be like a new set of eyes for the visually impaired: it will detect obstacles in the user's environment and will safely guide the user to their destination quickly and efficiently. Other various features such as emergency assistance will be provided to further assist the user. This system is mainly designed to be used by the visually impaired, their caretakers, and their families, but can also be used by anyone who needs extra help safely navigating indoors.

### 2.2. Problem Statement

The problem of	Navigating safely indoors while visually impaired
affects	Visually impaired people
The impact of which is	Uncertainty in the safety of visually impaired people as they navigate indoors
A successful solution would	A safe mobile indoor navigation system that can easily be learned and used by the visually impaired. The product

	would be like a new set of “eyes” for the visually impaired. This system includes the use of sensors such as GPS and Cameras in order to detect obstacles in the environment and allow the system to help the user safely navigate to their destination. Advanced features such as advanced navigation algorithms will also be utilized in order to bring path efficiency to the user.
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### 2.3. Product Position Statement

For	Visually impaired people
Who	Want a more safe and efficient way to get to their indoor destination
Theia Blind Indoor Navigation System	Is a software product
That	Provides real-time navigation that will guide the user to their destination safely and efficiently
Unlike	Currently available and less effective solutions such as using a Cane, using a Guide Dog, using Braille, using a Human Guide, or using a similar indoor navigation app
Our product	Provides Real-Time Audio Navigation, Obstacle Detection, Route Optimization, Customizable User Preferences, Emergency Assistance, and more advanced features

## 3. Stakeholder and User Descriptions

### 3.1. Market Demographics

The target market for this system is the visually impaired. The users are anticipated to be consumers who already use smartphones regularly in their day-to-day lives.

### 3.2. Stakeholder Summary

Name	Description	Responsibilities
Software Requirements Engineer	This is a stakeholder that translates the customer's	Responsible for producing the SRS (software requirements

	requests/needs into requirements to be used for design.	specification), which includes functional and non-functional requirements that fulfill the customer's requests/needs.
Software Architect	This is a stakeholder that designs the overall system using the requirements gathered by the Software Requirements Engineer.	Responsible for the software's architecture, which includes the design patterns that influence the overall design and implementation of the system.
Software Engineer	This is a stakeholder that develops the system as described by the Software Architect.	Responsible for developing the code that will implement the solution to the customer's problem, as described by the software architecture developed by the Software Architect.
Software Testing Engineer	This is a stakeholder that tests the system created by the Software Engineer.	Responsible for testing and evaluating the system produced by the Software Engineer as to ensure that the system fulfills all the requirements set by the Software Requirements Engineer.
Project Manager	This is a stakeholder that leads the overall system development.	Responsible for working with the customer to ensure their needs are met, delegating tasks to the development team, and overseeing the entire software project as to ensure its success.

### 3.3. User Summary

Name	Description	Responsibilities	Stakeholder
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Visually Impaired Person	Primary end user of the system	Uses Theia to help them navigate indoors safely to their correct destination.	Self
Caretaker of Visually Impaired Person	End user of the system	Assists the Visually Impaired Person with using Theia.	Self
Customer Care	End user of the system	Takes care of any issues that any end user may inquire about.	Self

### 3.4. User environment

Users access Theia through their mobile smartphones. Theia will be available on Android and Apple systems only.

Users will input their desired destination into Theia, which will then provide a set of auditory directions that will guide the user to their destination. As they navigate, their smartphone needs to be in front of them, with the camera pointing in the direction they move in order to help the user navigate their environment safely to their destination.

Caretakers of the Visually Impaired Person may assist the Visually Impaired Person with installing, setting up, and using Theia. Theia can also assist the Visually Impaired Person with the installation, set up, and use of Theia through auditory directions.

Customer Care will be available 24 hours, 7 days a week to answer questions and/or assist users with Theia.

### 3.5. Stakeholder Profiles

#### Software Requirements Engineer

<b>Description</b>	An individual who collects needs/requests from the stakeholders and translates those needs/requests into requirements.
<b>Type</b>	Expert user
<b>Responsibilities</b>	Collects needs/requests from the stakeholders, translates the needs/requests into requirements such as functional and non-functional

	requirements, and produces the Software Requirements Specification for use by other engineers on the team such as the Software Architect.
<b>Success Criteria</b>	Ability to correctly collect all of the needs/requests of the stakeholders, correctly translate those needs/requests into complete, traceable, testable, consistent, and feasible requirements, and produce a clear and useful Software Requirements Specification.
<b>Involvement</b>	All phases of the development cycle to ensure requirements are met in every phase.
<b>Deliverables</b>	Software Requirements Specification
<b>Comments / Issues</b>	None.

#### Software Architect

<b>Description</b>	An individual who uses the requirements to design the overall architecture of the system.
<b>Type</b>	Expert user
<b>Responsibilities</b>	Use Software Requirements Specification to make high-level design choices regarding Theia. Interact with stakeholders to assist with making high-level design choices regarding Theia. Collaborate with all of the other engineers on the team to ensure design quality and avoid overly complicated system structures.
<b>Success Criteria</b>	Ability to choose a design pattern that is best suited to Theia and create a software architecture that meets the non-functional requirements.
<b>Involvement</b>	All phases of the development cycle to ensure design quality and avoid overly complicated system structures.
<b>Deliverables</b>	Software Architecture and Design Document
<b>Comments / Issues</b>	None.

#### Software Engineer

<b>Description</b>	An individual who produces the code needed to implement the system based on the requirements and architecture previously produced.
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<b>Type</b>	Expert user
<b>Responsibilities</b>	Collaborate with all of the other engineers on the team to ensure everything is feasible to implement. Implement the system as described by the Software Requirements Specification and the Software Architecture documents. Identifying bugs and debugging the system. Documenting the system to ensure maintainability.
<b>Success Criteria</b>	Ability to implement Theia correctly as described by the Software Requirements Specification and Software Architecture documents. Ability to produce quality documentation to ensure maintainability.
<b>Involvement</b>	All phases of the development cycle to ensure everything is feasible to implement.
<b>Deliverables</b>	Theia's Code, User Manual, etc.
<b>Comments / Issues</b>	None.

### Software Testing Engineer

<b>Description</b>	An individual who creates and runs tests on the developed system to ensure it meets the needs/requests of the stakeholders.
<b>Type</b>	Expert user
<b>Responsibilities</b>	Create test plans, test cases, and test scripts. Collaborate with Software Engineers to identify and fix issues in the code such as bugs, vulnerabilities, etc. Analyze and interpret test results. Document tests.
<b>Success Criteria</b>	Ability to minimize the number of bugs, vulnerabilities, etc. in Theia. Ensure Theia meets the standards of the stakeholders.
<b>Involvement</b>	All phases of the development cycle as to ensure mostly everything is testable.
<b>Deliverables</b>	Test Plans, Test Cases, Tests Scripts, etc.
<b>Comments / Issues</b>	None.

### Project Manager

<b>Description</b>	An individual who oversees the project from start to finish.
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<b>Type</b>	Expert user
<b>Responsibilities</b>	Plans the project's scope, timeline, budget, etc. Communicates with stakeholders about project progress, risks, issues, etc. Manages risk. Manages resources. Monitors the quality of the deliverables. Manages the team and delegates tasks appropriately.
<b>Success Criteria</b>	Ability to finish the project on time, within budget, and satisfies all of the stakeholder's needs/requests.
<b>Involvement</b>	Oversees all phases of the development cycle.
<b>Deliverables</b>	Progress reports, Presentations, Risk Documents, etc.
<b>Comments / Issues</b>	None.

### 3.6. User Profiles

#### Visually Impaired Person

<b>Description</b>	A private individual that will use Theia to help them safely navigate indoors blindly without external help.
<b>Type</b>	Casual user
<b>Responsibilities</b>	May provide feedback on the software in the form of reviews during and after development of the software.
<b>Success Criteria</b>	Ability to get to their desired destination safely by following the instructions provided by Theia. Continued use of Theia.
<b>Involvement</b>	May provide feedback on the software in the form of reviews during and after development of the software.
<b>Deliverables</b>	Application Review for Developers
<b>Comments / Issues</b>	None.

#### Caretaker of the Visually Impaired Person

<b>Description</b>	A private individual who will assist their visually impaired patient with installation, setup, and use of Theia.
<b>Type</b>	Casual user

<b>Responsibilities</b>	May provide feedback on the software in the form of reviews during and after development of the software.
<b>Success Criteria</b>	Ability to get their visually impaired patient to their desired destination safely by following the instructions provided by Theia. The visually impaired patient's continued use of Theia.
<b>Involvement</b>	May provide feedback on the software in the form of reviews during and after development of the software.
<b>Deliverables</b>	Application Review for Developers
<b>Comments / Issues</b>	None.

### Customer Care

<b>Description</b>	An individual who will assist end users of Theia, including the Visually Impaired Person(s) and the Caretaker(s) of the Visually Impaired Person(s), with any problems they may have with Theia.
<b>Type</b>	Advanced user with experience in supporting similar apps like Theia
<b>Responsibilities</b>	Rapidly respond and resolve problems experienced by end users of Theia who reach out to Customer Care.
<b>Success Criteria</b>	Ability to eliminate or lower negative customer complaints about Theia.
<b>Involvement</b>	They are part of our internal customer support team.
<b>Deliverables</b>	End-user support manuals, Technical reference manuals, etc.
<b>Comments / Issues</b>	None.

### 3.7. Key Stakeholder or User Needs

<b>Need</b>	<b>Priority</b>	<b>Concerns</b>	<b>Current Solution</b>	<b>Proposed Solutions</b>
Navigate indoors safely using only a smartphone	High	Ability to reach the desired destination safely.	None	Using components of a mobile smartphone such as cameras, GPS, etc, Theia will guide the user to their desired destination safely via auditory directions.
Easy to use	High	Ability to	None	Use a simple GUI that has large

		provide intuitive use of Theia.		buttons that are easy to click. Minimize unnecessary buttons and pages so the user can get directions quickly and easily. Use voice commands to control Theia more easily.
Accessibility	High	Ability to use Theia while visually impaired.	None	Use a screen reader that uses audio feedback to read the screen to the user. Use a screen reader that uses haptic vibration feedback to read the screen in Morse code to the user. Use voice commands to control Theia.
Responsive	High	Ability to notify users of obstacles in the environment quickly.	None	Ensure notification latency of detected obstacle does not exceed 1 second.
Easy to contact emergency services	Medium	Ability to contact emergency services quickly and easily.	None	Implement a universal button that can be clicked to quickly contact emergency services in the event of an emergency.
Personalization	Low - Medium	Ability to personalize the settings of Theia.	None	Theia's settings will be toggleable and can be saved specifically for each account. Additionally, other personalization features such as contacts will be included.
Security	High	Ability to protect end-user data.	None	Theia shall employ a robust email and password authentication system to access the application. Also, the HIPAA Policy will be followed, to further protect the health information of our stakeholders.
Feasibility	Low	Ability to implement this system.	None	All planned features are completely feasible to implement so there is no concern for this.

### **3.8. Alternatives and Competition**

Limiting the scope of this project to the class, our competition includes the other groups developing their own blind indoor navigation app.

## **4. Product Overview**

### **4.1. Product Perspective**

The Theia Blind Indoor Navigation System is designed as a stand-alone application that integrates seamlessly with existing mobile technologies by utilizing sensors such as GPS, cameras, and a gyroscope to provide real-time navigation assistance to visually impaired users. Theia is not just an application but a comprehensive mobility solution that enhances the independence and safety of its users.

### **4.2. Summary of Capabilities**

- Real-Time Audio Navigation: Guides users with voice commands through indoor environments, adapting to real-time obstacles.
- Obstacle Detection: Employs advanced computer vision technologies to detect and alert users about obstacles in their immediate surroundings.
- Route Optimization: Calculates the most efficient routes based on user location, destination, and specific preferences such as avoiding stairs.
- Customizable User Preferences: Allows users to tailor navigation aids to their specific needs, including adjustable voice guidance and feedback sensitivity.
- Emergency Assistance: Integrates with emergency services to provide quick access to help in critical situations.

### **4.3. Assumptions and Dependencies**

- Assumptions
  - Users will have access to smartphones with the necessary sensor capabilities.
  - The app will operate within environments where adequate Wi-Fi or data services are available.
- Dependencies
  - Continuous access to updated indoor mapping data
  - Dependency on third-party services for emergency response features

### **4.4. Cost and Pricing**

- Free Version: Includes basic navigation features
- Premium Subscription: Offers advanced features such as detailed route history and customization.
- Institutional Licensing: Tailored for organizations like universities and public facilities, providing extensive customization and integration options

#### **4.5. Licensing and Installation**

- Licensing: Theia will be licensed per user under a subscription model. Bulk licensing options are available for educational and non-profit organizations.
- Installation: The application can be downloaded from the Apple App Store and Google Play Store. Installation involves a simple one-time process after which users can personalize their settings and start using the app immediately.

### **5. Product Features**

- Voice-Activated Navigation: Users can start navigation with simple voice commands, making the app hands-free and accessible even in complex indoor environments. This feature supports multiple languages to cater to a diverse user base.
- Intelligent Obstacle Avoidance: Integrates real-time object recognition to detect and warn users of obstacles in their path. This feature uses the smartphone's camera and advanced machine learning algorithms to ensure safety as users navigate.
- Customizable Route Settings: Offers users the ability to customize their routing preferences such as avoiding stairs or preferring less crowded paths. This personalization enhances the user's comfort and ease of travel within indoor spaces.
- Dynamic Rerouting: Automatically recalculates the route when a user deviates from suggested path or when new obstacles are detected. This ensures continuous guidance and adapts to changes in the environment.
- Emergency Services Integration: Provides a quick-access feature to contact emergency services and share the user's precise location within seconds in case of an emergency, enhancing the safety of the user under critical conditions.
- Open Source Mapping: People can map the building using the app, to provide it the data it needs for indoor navigation when assisting those that need it.

### **6. Constraints**

- Hardware Limitations: Theia requires smartphones equipped with GPS, cameras, and sufficient processing power. The performance and features may be limited on older or lower-spec devices.
- Environmental Limitations: Effective navigation is dependent on the availability of updated indoor maps and strong internet connectivity.
- System Dependency: Relies on the operating system's accessibility features to be fully functional, such as voice recognition and screen reading capabilities, which might vary across different platforms and versions.

### **7. Quality Ranges**

None specified.

## **8. Precedence and Priority**

From highest to lowest priority:

1. The system must have Real-Time Audio Navigation
2. The system must have Obstacle Detection
3. The system must have Emergency Assistance
4. The system must have Route Optimization
5. The system must have Customizable User Preferences

## **9. Other Product Requirements**

### **9.1. Applicable Standards**

- Theia shall follow HIPAA Policies and Regulations.

### **9.2. System Requirements**

- Theia will support Android and Apple operating systems only.

### **9.3. Performance Requirements**

- All key functionalities within Theia shall have a maximum latency of 2 seconds.
- Precise localization and GPS accuracy shall be within a margin of error not exceeding 3ft.
- The user shall be alerted of any detected obstacle or hazard with a notification latency not exceeding 1 second.
- Theia shall efficiently use sensors, cameras, and microphones to identify the presence of obstacles or hazards within a proximity of 5 feet of the user.

### **9.4. Environmental Requirements**

- To use Theia, there shall be at least one path in the user's environment that is safe to traverse from their starting point to their destination.

## **10. Documentation Requirements**

### **10.1. User Manual**

None required - The system will provide an easy-to-understand tutorial that is sufficient.

### **10.2. Online Help**

General and context-specific help will be available for all functions in the system. Additional customer support will also be available.

### **10.3. Installation Guides, Configuration, and Read Me File**

None required - The system will be easily accessible through mobile app stores.

### **10.4. Labeling and Packaging**

Not applicable.