Team FME

Theia
Vision

Version 1.0

Revision History

Date	Version	Description	Author
22/Nov/24	1.0	Initial Proposed Vision of Theia.	Kevin M. Justin L. Nhan N. Jason N. Nasen W.
11/25/24	1.1	Completed Vision Document	Kevin M. Justin L. Nhan N. Jason N. Nasen W.

Theia	Version:	1.0
Vision	Date: 24/Nov/24	
THEIA-VISION-01-2024-11-24		

Table of Contents

Vision

1. Introduction

1.1 Purpose

The purpose of this Vision document is to define the high-level requirements and features for the development of the Theia application. Theia is a navigation system designed to assist blind users in navigating indoor spaces safely and efficiently through voice guidance, obstacle detection, and fall notification systems.

1.2 Scope

The Theia application aims to provide indoor navigation for visually impaired individuals. Features include obstacle detection using smartphone cameras, shortest path calculation via building maps, voice command functionality, and emergency notifications in case of falls. The application is scoped for use in pre-mapped indoor environments such as offices and schools and may contain map

1.3 Definitions, Acronyms, and Abbreviations

- GUI: Graphical User Interface

- IMU: Inertial Measurement Unit

- Obstacle: Physical blockage of a route

- ADA: Americans with Disabilities Act

1.4 References

- Preliminary Project Plan

- WRS Document

- Phase 1 System Presentation

2. Positioning

2.1 Business Opportunity

There is a significant need for tools that enhance accessibility and safety for visually impaired individuals navigating indoor environments. Theia aims to fill this gap by leveraging smartphone technology for real-time navigation, object detection, and emergency response.

2.2 Problem Statement

The problem of	difficulty navigating indoor spaces for blind individuals
affects	visually impaired people and their caretakers
the impact of which is	increased risk of injury, reduced autonomy, and inefficient travel
a successful solution would be	a navigation system that provides real-time guidance, obstacle detection, and emergency support.

2.3 Product Position Statement

For	visually impaired individuals
Who	need reliable indoor navigation that experience challenges in safely navigating unfamiliar indoor environments,
The (product name)	Theia application is a smartphone-based navigation tool
That	provides real-time guidance, obstacle detection, and safety alerts.
Unlike	traditional aids such as canes or guide dogs,
Our product	offers flexibility, detailed navigation, and advanced safety features using pre-uploaded building maps.

3. Stakeholder and User Descriptions

3.1 Market Demographics

The target market for Theia consists primarily of visually impaired individuals who require assistance navigating indoor environments. There are billions of visually impaired people worldwide, with a significant percentage living in urban areas where they are frequently subjected to complex indoor spaces, like offices, universities, and public facilities.

- Target Market Segment: Individuals with visual impairments, caretakers, and organizations supporting accessibility solutions.

- Market Size: Approximately 2.2 billion people globally live with vision impairment or blindness. Among these, many are potential users of advanced mobility aids.

- Major Trends and Technologies: Increasing adoption of smartphone technologies, advancements in AI for navigation, and a rising demand for accessibility tools.

- Strategic Positioning Questions:
  - Reputation: The project aims to establish a reputation as a cutting-edge, user-friendly accessibility solution for visually impaired individuals.
  - Goals: Enhance autonomy and safety for visually impaired individuals, ensuring inclusivity and accessibility in complex indoor spaces.
  - Support for goals: Theia leverages the smartphone technologies to provide real-time navigation, obstacle detection, and safety alerts.

3.2 Stakeholder Summary

Caretaker	An individual responsible for assisting the primary user, ensuring their safety and comfort.	- Ensures that the user's emergency contacts are up-to-date. - Monitors user safety via emergency alerts. - Assists in initial app setup, such as uploading maps.
Emergency Services	Public or private entities providing emergency response (e.g., 911 services).	- Respond to alerts when users fall or encounter emergencies. - Provide timely medical assistance or safety interventions.
Developers	The team building the Theia system.	- Design and implement system functionality. - Ensure the system is maintainable and extensible. - Monitor project progress and resolve technical issues.
Building Administrators	Individuals responsible for the facilities where Theia will be used.	- Upload accurate building maps to the app. - Ensure environments are conducive to safe navigation.

3.3 User Summary

Visually Impaired Individuals	The primary users of Theia, relying on the app for indoor navigation.	- Use the app to navigate to specific destinations. - Follow voice guidance and obstacle warnings. - Provide feedback for improvements.	Caretaker
Caretakers	Individuals aiding visually impaired users.	- Set up the app by uploading building maps. - Ensure emergency contact details are current. - Support users in customizing app settings.	Developers
Facility Staff	Staff responsible for maintaining accessible spaces.	- Ensure that building maps are regularly updated. - Provide feedback on accessibility issues to developers.	Developers

3.4 User Environment

- Number of people involved: Typically one user per session, with occasional input from a caretaker during setup or emergency response.
- Task Cycle: Users typically engage with Theia intermittently during navigation tasks lasting a few minutes to an hour.
- Environmental constraints: Indoor use only, in environments such as offices, school,s or public spaces with pre-mapped layouts.
- System platforms: Compatible with modern smartphones running Android or iOS.
- Integration needs: Theia integrates with smartphone sensors (camera, IMU) and potentially Bluetooth and/or Wi-Fi beacons for enhanced accuracy.

Stakeholder Profiles

3.4.1 Caretaker

Representative	Caretaker representative (specific individuals not identified at this stage).
Description	Individuals responsible for assisting visually impaired users in their daily activities, including the use of the Theia application.
Type	Casual users; limited technical expertise expected, primarily concerned with the usability and reliability of the app.
Responsibilities	- Ensure the app is correctly set up with building maps and emergency contacts. - Monitor emergency alerts from the app. - Provide feedback to developers regarding functionality and usability issues.
Success Criteria	- The app successfully guides the visually impaired user without requiring frequent caretaker intervention. - Quick emergency response is available when needed.
Involvement	- Testing initial versions of the app. - Providing feedback during user acceptance testing (UAT). - Configuring and customizing the app settings for users.
Deliverables	- User feedback reports. - Testing results and suggestions for improving usability.
Comments / Issues	- Ensuring app reliability to reduce stress for caretakers. - Addressing any potential miscommunications in emergency alerts.

3.4.2 Emergency Services

Representative	Emergency response teams (e.g., local fire, medical, or police departments).
Description	Professionals tasked with responding to alerts from the Theia application in emergencies such as user falls or injuries.
Type	Experts; extensive training in responding to emergencies, relying on accurate location data from the app.
Responsibilities	- Respond promptly to alerts generated by the app. - Assist visually impaired users in emergency situations.

	- Coordinate with caretakers for user safety.
Success Criteria	- Accurate and timely alerts to reduce response time. - Clear and actionable data provided by the app during emergencies.
Involvement	- Receiving notifications and instructions directly from the app. - Providing feedback to developers regarding alert clarity and efficiency.
Deliverables	- Emergency response reports. - Feedback on system effectiveness in real-world use.
Comments / Issues	- Ensuring no false alerts are generated by the system. - Addressing any data transmission delays or errors in location data.

Developers

Representative	Development team for the Theia application.
Description	The team responsible for designing, developing, and maintaining the Theia system.
Type	Technical experts; proficient in software development, user experience design, and system testing.
Responsibilities	- Develop and implement app features, including navigation, obstacle detection, and emergency alerts. - Ensure system reliability and scalability. - Provide updates and patches based on user and stakeholder feedback.
Success Criteria	- App meets all functional and non-functional requirements. - High user adoption and satisfaction rates. - Minimal system errors or crashes.
Involvement	- Continuous development and iteration of the app. - Addressing bugs and issues raised during user testing. - Engaging with stakeholders to refine requirements.
Deliverables	- Fully functional Theia application. - Technical documentation and user manuals. - Regular updates and patches.
Comments / Issues	- Managing scope creep to ensure timely delivery. - Addressing any compatibility issues with different smartphone models.

3.4.3 Building Administrators

Representative	Building management teams responsible for indoor facilities.
Description	Individuals ensuring the indoor spaces are accessible and navigable for visually impaired users.
Type	Intermediate users; some technical expertise in managing building maps and accessibility features.
Responsibilities	- Upload accurate building maps to the system. - Ensure spaces are compliant with accessibility standards. - Provide updates on changes to the building layout.

Success Criteria	- Maps are consistently accurate and up-to-date. - Building spaces are safe and accessible for Theia users.
Involvement	- Collaborating with developers to provide accurate building data. - Ensuring timely updates for any modifications to indoor layouts.
Deliverables	- Accurate building maps. - Accessibility compliance reports.
Comments / Issues	- Ensuring all relevant updates are communicated to developers. - Addressing accessibility issues in older or non-compliant buildings.

3.5   User Profiles

3.5.1   Visually Impaired Individuals

Representative	Visually impaired user representatives (specific individuals or user advocacy groups).
Description	Individuals who are blind or visually impaired and rely on the Theia application for safe and efficient indoor navigation.
Type	Casual users with little to no technical expertise. Primarily concerned with usability and reliability of navigation instructions.
Responsibilities	- Use the app to navigate through indoor spaces. - Follow the voice instructions and obstacle warnings. - Provide feedback on the app's functionality and usability.
Success Criteria	- Successful navigation without accidents or collisions. - Timely guidance and rerouting in case of obstacles. - Confidence and independence while navigating.
Involvement	- Testing the app during pilot phases. - Providing feedback on accessibility features and voice interface.
Deliverables	- User experience reports and feature improvement suggestions.
Comments / Issues	- Difficulty adapting to technological interfaces for novice users. - Potential frustration with inaccuracies or delays in guidance.

3.5.2   Caretakers

Representative	Family members or professional aides for visually impaired users.
Description	Individuals who assist visually impaired users with daily tasks, including setting up and using the Theia application.
Type	Casual users; limited technical expertise but familiar with the specific needs of the visually impaired.
Responsibilities	- Configure the app settings, such as uploading maps and adding emergency contact details. - Respond to notifications generated by the app in case of emergencies. - Train the user on how to interact with the app.
Success Criteria	- The app operates seamlessly, reducing the workload for caretakers.

	- Reliable emergency alert system that minimizes false alarms.
Involvement	- Participating in setup and training phases. - Monitoring the user's progress and adapting settings as needed.
Deliverables	- Configuration reports and ongoing feedback to developers.
Comments / Issues	- Challenges in explaining complex app features to users. - Addressing any technical difficulties that arise during use.

3.5.3 Building Administrators

Representative	Facility management staff responsible for maintaining accessible spaces.
Description	Individuals tasked with ensuring the indoor spaces are accessible and mapped correctly for Theia users.
Type	Intermediate users with some technical expertise in managing digital systems and building layouts.
Responsibilities	- Upload building maps and update layouts in the Theia system. - Ensure indoor environments comply with accessibility standards. - Collaborate with developers to address mapping issues.
Success Criteria	- Accurate building maps that lead to seamless navigation for users. - Positive feedback from Theia users regarding indoor accessibility.
Involvement	- Updating maps and responding to issues related to building layouts. - Reporting accessibility challenges to developers.
Deliverables	- Digital building map files and maintenance reports.
Comments / Issues	- Delays in updating building layouts could affect navigation accuracy. - Challenges in ensuring older buildings meet accessibility requirements.

4.   Product Overview

4.1   Product Perspective

The Theia application is an independent, smartphone-based navigation tool designed to aid visually impaired users in navigating indoor environments safely and efficiently. It relies on smartphone sensors, such as cameras and IMUs, along with pre-uploaded building maps, to provide real-time guidance and obstacle detection.

- Integration with other systems: Theia operates as a standalone system but requires collaboration with building administrators to upload accurate indoor maps. It does not depend on external hardware beyond the smartphone but leverages emergency services infrastructure for alerts in case of user emergencies.
- Interfaces: The app interfaces with:
  - Pre-uploaded building maps for navigation.
  - Smartphone sensors (camera, IMU, GPS).
  - Communication systems (to alert caretakers and emergency services in emergencies).
- Theia is compatible with modern smartphones running Android or iOS and requires active internet or pre-downloaded data for full functionality.

4.2   Summary of Capabilities

Table 4-1   Summary of Theia Capabilities

Customer Benefit	Supporting Features
Blind users can navigate indoor spaces independently and safely.	Pre-uploaded building maps and voice-guided instructions provide step-by-step navigation for users.
Users are warned of obstacles before encountering them.	Real-time obstacle detection using the smartphone camera alerts users and provides alternative routes if needed.
Emergency assistance is quickly accessible in case of incidents.	Fall detection triggers automatic alerts to emergency contacts and emergency services.
Caretakers can configure settings and monitor alerts easily.	User-friendly customization options allow adjustments for volume, language, and emergency contact details.
Building administrators can maintain accurate navigation data.	Map upload and update tools ensure that routes reflect real-time building layouts.
The system is adaptable to different user needs and environments.	Customizable features and support for multiple languages enhance usability for diverse user groups.

4.3   Assumptions and Dependencies

1. Assumptions:
   - Users will have access to modern smartphones with functional cameras, IMU sensors, and sufficient processing power.
   - Building administrators will upload accurate and up-to-date indoor maps to the system.
   - Emergency services are accessible and can respond promptly to alerts generated by the application.
   - Internet connectivity will be available during map uploads and emergency notifications, although offline navigation features will function with pre-downloaded maps.

2. Dependencies:
   ● The app relies on pre-uploaded building maps to provide accurate navigation instructions. Outdated or missing maps may compromise functionality.
   ● The smartphone's camera and IMU sensors must operate correctly for obstacle detection and fall detection features to function.
   ● System performance depends on stable network connections for real-time updates, notifications, and map synchronization.

5. Product Features

5.1 Indoor Navigation

Description:

Theia provides step-by-step navigation for visually impaired users to guide them through indoor spaces. Using pre-uploaded building maps and voice instructions, the app determines the shortest or most comfortable route to a destination.

Key Capabilities:
   ● Generates real-time voice instructions for navigation.
   ● Offers alternative routes in case of obstacles or closures.

Usability Considerations:
   ● Voice instructions are clear and customizable (e.g., volume, language, frequency).

5.2 Obstacle Detection

Description:

The app leverages smartphone cameras to detect obstacles in the user's path, such as furniture, maintenance equipment, or unexpected blockages. It alerts users in real-time to avoid collisions and suggests detours.

Key Capabilities:
   ● Real-time visual analysis to identify obstacles.
   ● Provides audible warnings and suggested reroutes.

Usability Considerations:
   ● Alerts must be timely and unambiguous.
   ● Accurate detection to avoid false positives or negatives.

5.3 Emergency Response

Description:

In case of user falls or emergencies, Theia uses IMU sensors to detect sudden movements or impacts. The app automatically notifies designated caretakers or emergency services with the user's location.

Key Capabilities:
- Fall detection using accelerometers and IMUs.
- Automated alerts sent to emergency contacts and services.

Usability Considerations:
- False alerts should be minimized.
- Users can cancel alerts within a grace period if no assistance is needed.

6.   Constraints

1. Design Constraints:
   - Theia must operate exclusively on modern smartphones with functional cameras and sensors.
   - Pre-uploaded building maps are mandatory for navigation; the app cannot generate routes without them.
   - The application must provide accurate navigation within the limitations of map data and sensor precision.
2. External Constraints:
   - Building administrators are responsible for uploading and maintaining accurate and updated map data.
   - Emergency response services depend on network availability for timely alerts and location sharing.
3. Dependencies:
   - Reliance on smartphone hardware (camera, IMU, GPS) for core functionalities such as navigation and obstacle detection.
   - Availability of stable network connectivity for map synchronization and emergency alert functionality.

7.   Quality Ranges

Theia must adhere to the following quality standards to ensure a reliable and user-friendly experience:

1. Performance:
   - Navigation instructions should be delivered within 1 second of a user's movement or detected change in route.
   - Obstacle detection alerts must occur at least 5 feet (1.5 meters) before the obstacle is encountered.
2. Robustness:
   - The app must function reliably across various indoor environments, regardless of network conditions.
   - Navigation must not be affected by minor GPS inaccuracies or sensor variations.
3. Fault Tolerance:
   - In the event of hardware or network failures, the system should revert to preloaded map-based guidance where feasible.
   - Emergency alerts must retry sending notifications until confirmed as delivered.
4. Usability:
   - Voice instructions must be clear, concise, and understandable by non-technical users.
   - Visual and haptic feedback (where applicable) must support users effectively.
5. Reliability:
   - The system should maintain an uptime of 99.5% or higher to ensure continuous usability.

8.   Precedence and Priority

Theia's features are prioritized to focus on core functionality and user safety. The priorities are as follows:

1. High Priority:
   - Indoor Navigation: Accurate, step-by-step guidance to help visually impaired users navigate through buildings.
   - Obstacle Detection: Real-time detection and notification of obstacles to ensure user safety.
   - Emergency Response: Immediate fall detection and alerting to caretakers and emergency services.
2. Medium Priority:
   - Map Uploads and Updates: Ensuring building maps are consistently accurate and reflect the current layouts.
   - Device Compatibility: Supporting functionality across a range of modern smartphones with necessary hardware capabilities.
3. Low Priority:
   - Additional Features: Future expansions or enhancements that go beyond the core functionalities, such as integration with new sensors or advanced analytics.

9.   Other Product Requirements

9.1   Applicable Standards

Theia must comply with the following standards:

- Accessibility Standards: Adheres to ADA guidelines for accessibility.
- Platform Compliance: Supports major mobile operating systems, including Android and iOS.
- Safety and Quality Standards: Complies with ISO standards for software reliability and safety.

9.2   System Requirements

- Supported Platforms: Android or iOS.
- Hardware Requirements: Devices must have a functional camera, IMU sensors, and sufficient processing power.

9.3   Performance Requirements

- Response Time: Navigation instructions and obstacle alerts must be delivered within 1 second of detecting changes.
- Throughput: Capable of processing real-time sensor data without delays.
- Accuracy: Must detect obstacles within a 95% accuracy threshold and fall events within a 90% threshold.
- Reliability: System uptime of at least 99.5% is required.

9.4 Environmental Requirements

- User Environment: Operates effectively in indoor environments with varying lighting conditions and potential Wi-Fi interruptions.
- Hardware Environment: Designed to function in smartphones with capable hardware capabilities.
- Recovery: Automatically retries sending emergency alerts in the event of a network failure.

10. Documentation Requirements

10.1 User Manual

Purpose:

The User Manual will provide visually impaired users, their caretakers, and administrators with step-by-step guidance on how to install, configure, and use the Theia application for indoor navigation and safety.

Contents:

- Introduction: Overview of the application, its purpose, and its main features.
- Getting Started: Installation instructions, system requirements, and initial setup.
- Navigation Guide: Instructions on using navigation features, including initiating routes and understanding voice commands.
- Obstacle Alerts: Explanation of how obstacle detection works and what alerts mean.
- Emergency Notifications: Steps to set up emergency contacts and handle fall detection alerts.
- Troubleshooting: Common issues and solutions, including resetting the app or updating maps.
- Glossary: Definitions of key terms used in the application and manual.

Level of Detail:

The manual will be user-friendly, written in simple language, and optimized for visually impaired users (e.g., compatible with screen readers and available in large print formats).

Formatting and Delivery:

- Available as an accessible PDF for download.
- Physical large-print copies and Braille versions for users who require them.
- Tutorial-style content with diagrams or screenshots (where applicable) for caretakers and administrators.

A   Feature Attributes

A.1 Status

Proposed	Features currently under discussion but not yet approved by the project management team or stakeholders.
Approved	Features deemed feasible and beneficial, officially approved for implementation by the project management team.
Incorporated	Features successfully integrated into the application and available in the product baseline.

A.2 Benefit

Critical	Essential features that must be implemented to meet the core objectives of the system and ensure usability for the target audience.

Important	Features enhancing the system's efficiency and effectiveness but can be delayed if necessary without compromising the system's core objectives.
Useful	Features that provide additional convenience or functionality but are not essential to the system's initial release or primary functionality.

A.3   Effort

The amount of development time and resources needed to implement features. Estimations will include:

- Developer hours or team capacity needed.
- Complexity level based on required integrations or innovations.

A.4   Risk

Risk Level	Description
High	Features with significant uncertainty, such as technical feasibility or high resource demands, potentially delaying project timelines.
Medium	Features with manageable risks, such as minor integration challenges or moderate resource requirements.
Low	Features with minimal risks that can be implemented with existing capabilities and resources.

A.5   Stability

Features are categorized by their likelihood to remain unchanged or require reevaluation:

- Stable: Features that are well-defined and unlikely to change.
- Unstable: Features that may change based on evolving user requirements or technical discoveries.

A.6   Target Release

Features are assigned a release version for planning and scheduling. Example:

- Target Release 1.0: Core features like navigation, obstacle detection, and emergency notifications.
- Future Release: Enhancements or additional functionalities requiring further development.

A.7   Assigned To

- Development teams will be assigned specific features based on expertise, ensuring accountability and streamlined implementation.

A.8   Reason

Each feature must have a clear rationale, documenting why it is necessary. This may include:

- Addressing specific user needs or safety requirements.
- Aligning with project goals or compliance standards.