Comet-Vision

Vision Document

SE6361.001: Advanced Requirements Engineering

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Revision History

Date	Version	Description	Author(s)
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Table of Contents

1. Introduction

1.1 Purpose

The main purpose of this vision document is to list the requirements of the Comet-Vision Indoor Navigation Application. This document also helps us to collect and analyze the ideas we gathered for the application. This vision document will be subject to change if more requirements are added to the project. This vision document is mainly prepared to set the stage for the design phase of the project. The document focuses on the requirements needed by the stakeholders and the end users and why they are needed. The detailed requirements analysis is provided in this document.

1.2 Scope

This document is composed for the Comet-Vision Indoor Navigation Application, which will be developed by the Comet-Vision team. This vision document will cover the product positioning, which includes the business opportunities in blind people and related beneficiaries target markets. In addition, this document will also include product overview, product features, such as voice assistance, prioritized route selection, obstacle detection. Moreover, this document will also include product constraints, such as security, usability, and more.

1.3 Definition, Acronyms, and Abbreviations

Comet-Vision – Comet-Vision Indoor Navigation Application

Android – The Google operating system running on the smart phone. It is the target smart phone OS for use in subsequent development effort.

GPS – Global Positioning System

UIUX – User Interface and User Experience

FR – Functional Requirement

NFR – Non-Functional Requirement

IDEF0 – Integration Definition for Process Modelling

RE – Requirement Engineering

PIG – Problem Interdependency Graph

SIG – Soft-goal Interdependency Graph

1.4 References

Project II Specifications by Dr. Lawrence Chung

Vision Document Template

IBM Engineering Lifecycle Management:

https://www.ibm.com/docs/en/elm/7.0.0?topic=requirements-vision-document

Vision Document Airline Reservation System:

http://people.cs.ksu.edu/~kaavya/Vision%20Document_MSE_Phase%20I.pdf

2. Positioning

2.1 Business Opportunity

According to the National Dissertation Center for Children with Disabilities report, the rate of 12.2 per 1000 legal or total blindness occurs at a rate of 0.06 per 1000. Current special education demographics obtained from the American Foundation for the Blind 2009 report that there are:

- 93,600 students who are visually impaired or blind.
- 55,200 students who are legally blind.
- 5,500 braille readers

Under the American with Disabilities Act and Section 504 of the Rehabilitation Act, colleges are required to ensure their programs are accessible. During the past five to ten years, accessibility has become a concern across colleges throughout the whole country. Currently, there is no easy-to-use, cheap, mobile solution to solve these problems created by vision impairment. Therefore, developing such a smartphone application to facilitate indoor navigation can be strongly desired by the target market. Moreover, an available, easy-to-use indoor navigation indoor application can add to the factors that a student with visual impairment may look for when searching for the desired university. With the assistance of such an application, students with visual impairment would love to step out of the home and enjoy more of their daily life. In summary, developing such an application would imply a huge business opportunity for many universities, starting at UTD.

2.2 Problem Statement

The problem of	Visually impaired people unable to safely navigate indoors in buildings on campus at UTD due to certain limitations of preexisting tools such as a cane, dog, or an assistant
affects	Visually impaired students, faculty, staff, and visitors of UTD
the impact of which	Getting injured due to undetected obstacles, getting lost while navigating to their destinations, and arriving to class or desired destinations late and not on time
a successful solution will be	Creating a smartphone application that will help the users navigate safely and promptly to their destinations by providing clear and accurate directions (# of steps, which direction to turn, and obstacle detection)

2.3 Product Position Statement

For	The visually impaired students, faculty, staff, and visitors of UTD. Also including their family members, their caretakers.
Who	Have the need to use assistance for indoor navigation or need to help visually impaired people by receiving emergency alerts sent from the smartphone application.
Comet-Vision	Is an indoor navigation smartphone application
That	Provides the visually impaired students with assistance to navigate indoors and can perform obstacle detection to protect students from getting injured.
Unlike	Current applications that are not tailored for UTD students to navigate indoors on campus and are not intelligent enough to select the most optimal route as well as perform obstacle detection. Also, the current state of students using white canes, guide dogs, or an assistant/a volunteer.
Our product	Is an intelligent indoor navigation assistant that helps UTD students with their daily activities. It will allow the users to communicate with the application using voice recognition and haptic/sound feedback.

3. Stakeholder and User Descriptions

3.1 Market Demographics

The target market will include UTD students or anyone who needs to visit the UTD campus who has visual impairment with the need to walk indoors. Also, the target market segment includes people who need to provide assistance for the visually impaired people such as their family members and other caretakers. Users using this application are anticipated to own a smartphone device and already be comfortable with using a navigation application on their devices.

In terms of the operating system on which our application will be running, Android devices have a larger user base compared to iOS devices. The average price for all paid applications downloaded is relatively lower than the average price for its iOS counterpart. This shows that the Android platform offers a significantly cheaper alternative than some of its competitors. Therefore, we decided to utilize this advantage and target the Android users for this development.

3.2 Stakeholder Summary

The following table lists the non-user stakeholders of this application along with the description and their responsibilities.

Name	Description	Responsibilities
Project Manager	Working as the coordinator among everyone who is involved in the development process. Manage the resources and set up timeline for development.	- Monitors the project's progress - Coordinate with all stakeholders - Assign tasks among stake holders - Manage project resources
Product Manager	Study the market demographics and the current available applications in the market. Design the product features to ensure the project success.	- Ensures that there will be a market demand for the product's features - Design features for the product - Study other competitor applications available on the market
Requirement Engineer	Gather information to correctly describe and translate the requirements given by the customers.	- Communicate with project manager and software developers - Correctly translate what the customer needs into requirements - Provide an explanation for both parties if needed
UI/UX Engineer	Create the design of user interface for software engineers to implement. Improve the user experience of the application.	- Create user-friendly interfaces that are easy to use - Improve user experiences
Software Architect	Create and maintain the infrastructure of the application and communicate with every stakeholder to make sure all requirements are met.	- Ensures that the system will be maintainable - Create the high-level architecture of the application - Ensure both the technical team and product team can understand the architecture of the product. - Understand the technical details of the system and provide guidance for the development team
Software Developer	Develop the code to implement all features and user interfaces for the application.	- Write code to implement product features and make sure the assigned

		tasks are accomplished on time with excellent quality - Communicate and coordinate with the project manager and other developers if any issues need to be addressed
Quality Assurance Engineer	Perform system testing to make sure all features are correctly implemented and behaved	- Perform various tests against the system to ensure a decent quality of the system - Ensure features are correctly and completely implemented

3.3 User Summary

Name	Description	Responsibilities	Stakeholder
The visually impaired students, faculty, staff, and visitors of UTD	The primary end user of the application. The application provides voice assistance for users to navigate indoors.	- Use the application to navigate indoors - Use the application to send emergency messages if any accidents occur	Self
UTD emergency department (ex. campus police)	The secondary end user of the application. Provide help and emergency support for the visually impaired people when emergency messages are received.	- Receive emergency messages if any accidents occur - Produce emergency reports	Self
Family members or caretakers of the visually impaired people	The secondary end user of the application. Set up the application for visually impaired people. Provide care needed by visually impaired people.	- Set up the application for visually impaired people - Receive emergency messages if any accidents occur	Self

3.4 User Environment

The Comet-Vision smartphone application will be running on Android devices. Our application will include services such as speech to text conversion, object recognition, motion detection, emergency services, and more. The Android operating system of the users should be updated to the respective version which should support all features that are implemented in our application.

3.5 Stakeholder Profiles

3.5.1 Project Manager

Representative	Project Manager
Description	Working as the coordinator among everyone who is involved in the development process. Manage the resources and set up timeline for development.
Type	This individual shall have a good understanding of the scope of the project and have great communication and coordination skills to manage the resources within the project team and make sure tasks are accomplished within the deadline.
Responsibilities	- Monitors the project's progress - Coordinate with all stakeholders - Assign tasks among stake holders - Manage project resources

Success Criteria	Success is defined for the project manager as being able to effectively communicate and coordinate among all stakeholders and successfully manage the resources and project deadline.
Involvement	The project manager will be involved throughout the entire system development process.
Deliverables	Well-functioning application and relevant documentation
Comments/Issues	N/A

3.5.2 Product Manager

Representative	Product Manager
Description	Study the market demographics and the current available applications in the market. Design the product features to ensure the project success.
Type	This individual shall have a good understanding of the target market and how to translate the customer requirements into the product features.
Responsibilities	- Ensures that there will be a market demand for the product's features - Design features for the product - Study other competitor applications available on the market
Success Criteria	Success is defined for the product manager as being able to correctly understand the needs of the target market and having a well-rounded study of other competitor applications available on the market.
Involvement	The product manager will be involved throughout the entire system development process.
Deliverables	The product requirement and specification documents
Comments/Issues	N/A

3.5.3 Requirement Engineer

Representative	Requirement Engineer
Description	Gather information to correctly describe and translate the requirements given by the customers.
Type	This individual shall have solid domain-related knowledge and good communication skills to correctly gather customers' needs and translate them into formal requirement documents.
Responsibilities	- Communicate with project manager and software developers - Correctly translate what the customer needs into requirements - Provide explanation for both parties if needed.
Success Criteria	Success is defined for the requirement engineer as being able to completely gather customers' requirements and accurately translate them into formal requirement documents for the development team to use.
Involvement	The requirement engineer will be involved in the requirement phase and the beginning of development phase
Deliverables	Formal requirement document
Comments/Issues	N/A

3.5.4 UI/UX Engineer

Representative	UI/UX Engineer
Description	Create the design of user interface for software engineers to implement. Improve the user experience of the application.
Type	This individual shall have good skills in user interface design and solid knowledge of improving user experience.
Responsibilities	- Create user-friendly interfaces that are easy to use

	- Improve user experiences
Success Criteria	Success is defined by how intuitive the user interface design is. There should be no issues with navigation between all screens and the GUI should be nice-looking.
Involvement	UI/UX engineers will be involved in the requirement phase and the beginning of development phase.
Deliverables	The mockup designs
Comments/Issues	N/A

3.5.5 Software Architect

Representative	Software Architect
Description	Create and maintain the infrastructure of the application and communicate with every stakeholder to make sure all requirements are met.
Type	The software architect shall have a solid understanding of software architecture and design patterns and good communication and management skills to provide guidance or assistance for the development team if any issues rise up.
Responsibilities	- Ensures that the system will be maintainable - Create the high-level architecture of the application - Ensure both the technical team and product team can understand the architecture of the product. - Understand the technical details of the system and provide guidance for the development team
Success Criteria	
Involvement	Software architect will be involved throughout the requirement phase and the entire development phase.
Deliverables	The system architecture document and the framework of the system.
Comments/Issues	N/A

3.5.6 Software Developer

Representative	Software Developer
Description	Develop the code to implement all features and user interfaces for the application.
Type	The software developer shall have good programming skills and can accurately understand the requirements specified in the documents.
Responsibilities	- Write code to implement product features and make sure the assigned tasks are accomplished on time with excellent quality - Communicate and coordinate with the project manager and other developers if any issues need to be addressed
Success Criteria	Success is defined by how well the application is built and if all requirements specified in the documents are completely and correctly implemented and if the well-functioning application satisfies the stakeholders' need.
Involvement	The software developers will spend most of their time in the development process, but they will also spend some time on the requirement phase to better understand the requirement.
Deliverables	The well-functioning application
Comments/Issues	N/A

3.5.7 Quality Assurance Engineer

Representative	Quality Assurance Engineer
Description	Perform system testing to make sure all features are correctly implemented and behaved

Type	The quality assurance engineer shall have good skills in software testing techniques and good communication skills to collaborate with development teams.
Responsibilities	- Perform various tests against the system to ensure a decent quality of the system - Ensure features are correctly and completely implemented
Success Criteria	Success is defined by how well the testing is performed and meets the deadline and if issues are detected as many as possible.
Involvement	The quality assurance engineer will be involved at the end of the development phase and the entire testing phase.
Deliverables	Testing report
Comments/Issues	N/A

3.6 User Profiles

3.6.1 The visually impaired students, faculty, staff, and visitors of UTD

Representative	The visually impaired students, faculty, staff, and visitors of UTD
Description	The primary end user of the application. The application provides voice assistance for users to navigate indoors.
Type	The visually impaired people shall have a basic knowledge of how to use an Android cellphone.
Responsibilities	- Use application to navigate indoors - Use application to send emergency messages if any accidents occur
Success Criteria	Success is defined by the user successfully walking from start point to destination without bumping into any obstacles.
Involvement	Users will be involved in the requirement process to participate in the market research by filling out the questionnaires designed by requirement engineers. Users will also be involved in the testing process to help evaluate the prototype and provide feedback.

3.6.2 UTD Emergency Department

Representative	UTD emergency department
Description	The secondary end user of the application. Provide help and emergency support for the visually impaired people when emergency messages are received.
Type	The staff of UTD emergency department shall have a basic knowledge of how to use the navigation system.
Responsibilities	- Receive emergency messages if any accidents occur - Produces emergency reports
Success Criteria	If the user can receive an emergency message within 10 minutes and arrive at the correct location where the visually impaired person is, the application is considered successful.
Involvement	Users will be involved in the requirement process to participate in the market research by filling out the questionnaires designed by requirement engineers. Users will also be involved in the testing process to help evaluate the prototype and provide feedback.

3.6.3 Family members or caretakers of the visually impaired people

Representative	Family members or caretakers
Description	The secondary end user of the application. Set up the application for visually impaired people. Provide care needed by visually impaired people.
Type	The family member or caretakers shall have a basic knowledge of how to use the navigation system.
Responsibilities	- Set up the application for visually impaired people

	- Receive emergency messages if any accidents occur
Success Criteria	If the user can use the application to help the visually impaired person navigate indoors safely, the application is considered successful.
Involvement	Users will be involved in the requirement process to participate in the market research by filling out the questionnaires designed by requirement engineers. Users will also be involved in the testing process to help evaluate the prototype and provide feedback.

3.7 Key Stakeholder or User Needs

Need	Priority	Concerns	Current Solution	Proposed Solutions
Usability	High	The application should be well-functioning	None	Provide intuitive user interface for communication
Safety	High	The application should ensure the safety of the visually impaired person	None	Ensure obstacle detection, indoor navigation and emergency service work correctly as expected.
GPS	High	Provide navigation service with global positioning system	None	Google map API provides accurate positioning and navigation for users.
Object recognition	High	Detect the obstacles in the way of the visually impaired person	None	Recognize obstacles in the way of the users by camera capture and machine learning algorithm
Speech to text converter	High	Covert speech to text	None	Voice recognition service provided by Android captures speeches and converts them into text for users.
Voice assistance	High	Provide vocal guidance for visually impaired people to navigate indoors safely	None	Voice assistance service provided by Android SDK
Emergency call service	High	Send emergency messages or dial emergency calls to the UTD emergency department to alert the staff about the visually impaired person's status and location	None	Emergency call system provided by Android SDK to access user contact list and automatically send out messages by AWS cloud services.

3.8 Alternatives and Competition

- Applications which have similar features are available on Google Play, such as ***MapsPeople***, ***Navigine***, and ***Steerpath***. These commercial applications normally charge a

certain amount of fee for people to use. However, our Comet-Vision application will be free for all UTD students to use.

- Applications which have similar features are available on the Apple Store for iOS devices, such as ***Indoo.rs Visually Impaired App*** and ***Clew***. These two apps are different from our application in that they are offered for iOS devices, and they are only useful for retracing previous paths the users took. However, our Comet-Vision application will take new paths the users haven't taken into consideration to create a good, customized path.
- There are other competing indoor navigation applications made by teams in Advanced Requirements Engineering class at the University of Texas at Dallas.

4. Product Overview

4.1 Product Perspective

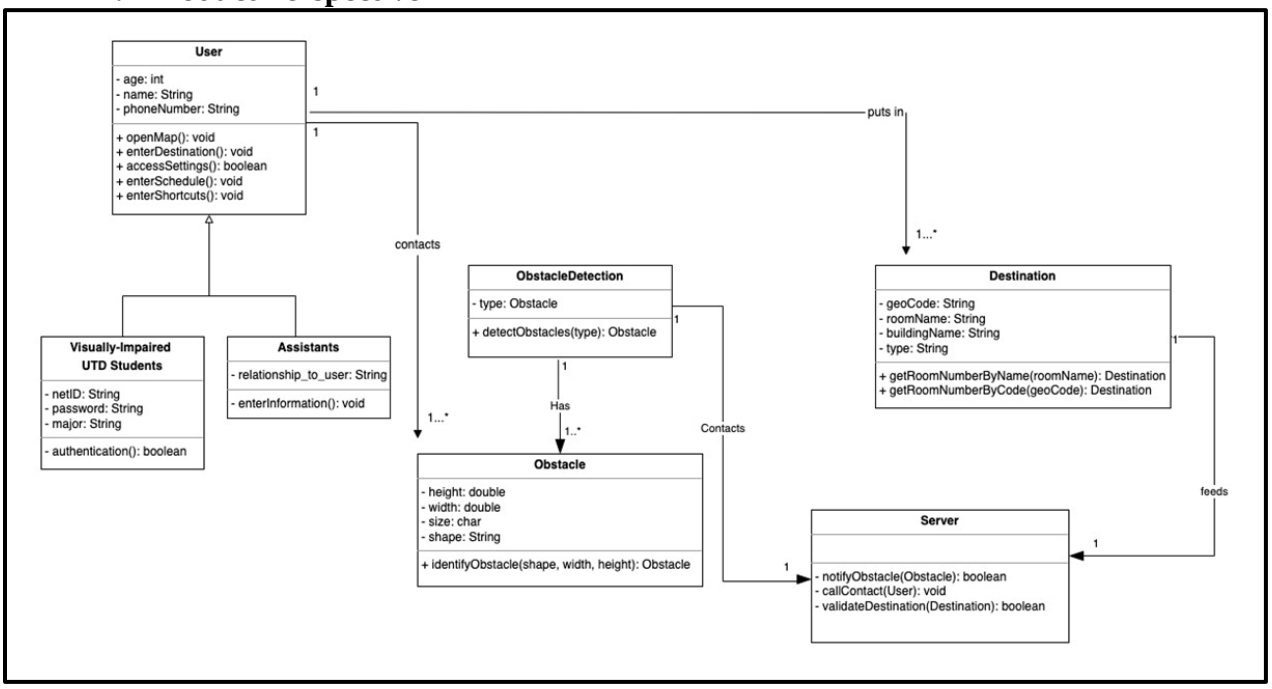


Figure 1. Class Diagram of Comet-Vision

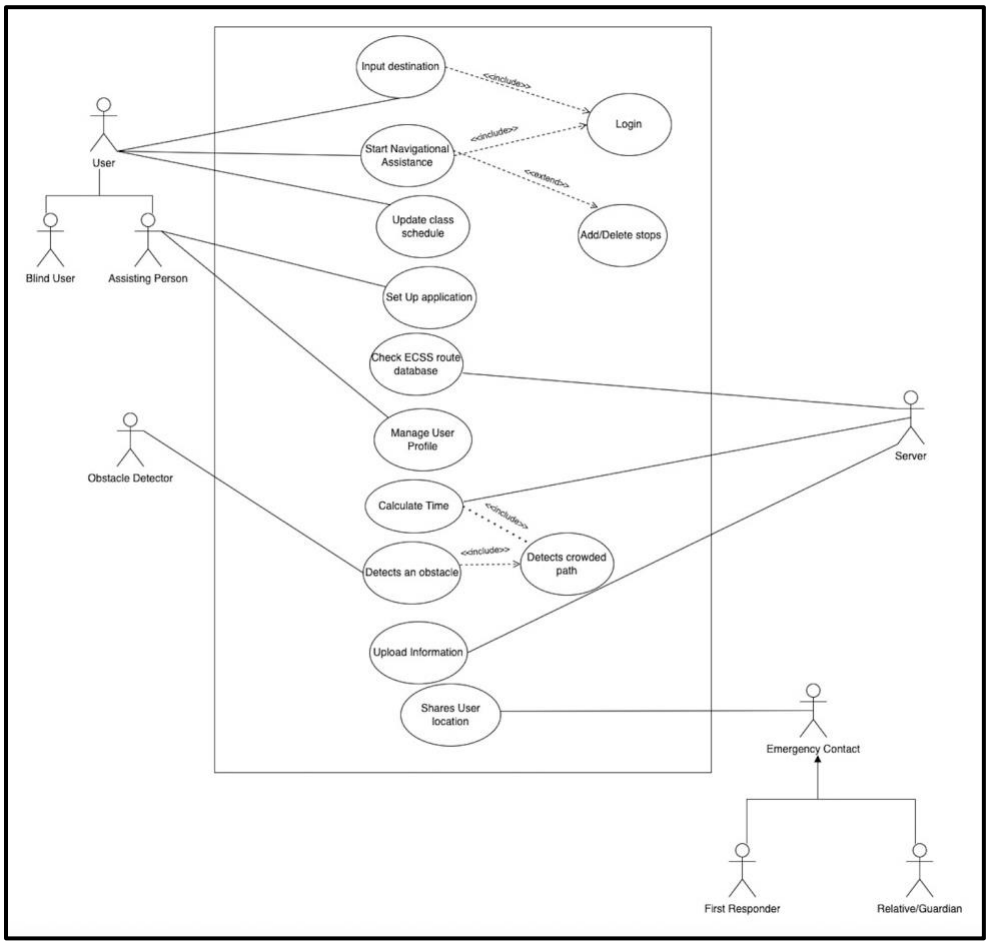


Figure 2. Use Case Diagram of Comet-Vision

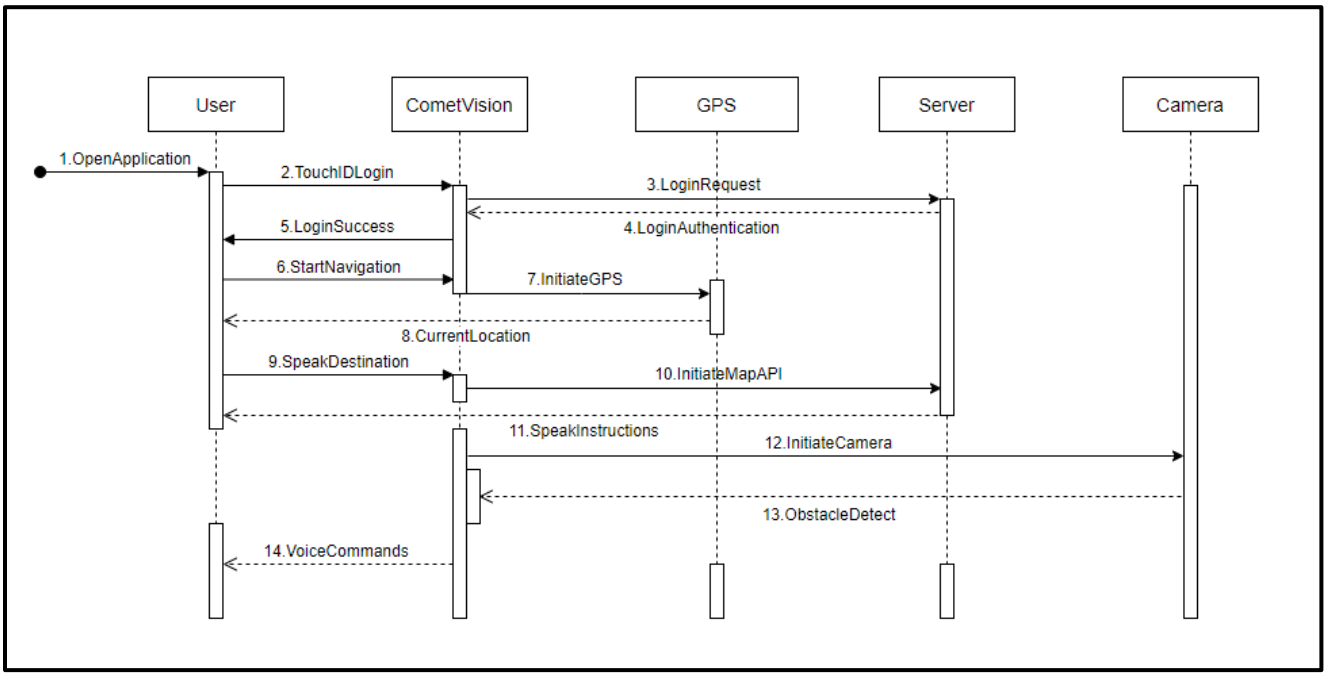


Figure 3. Sequence Diagram of Comet-Vision

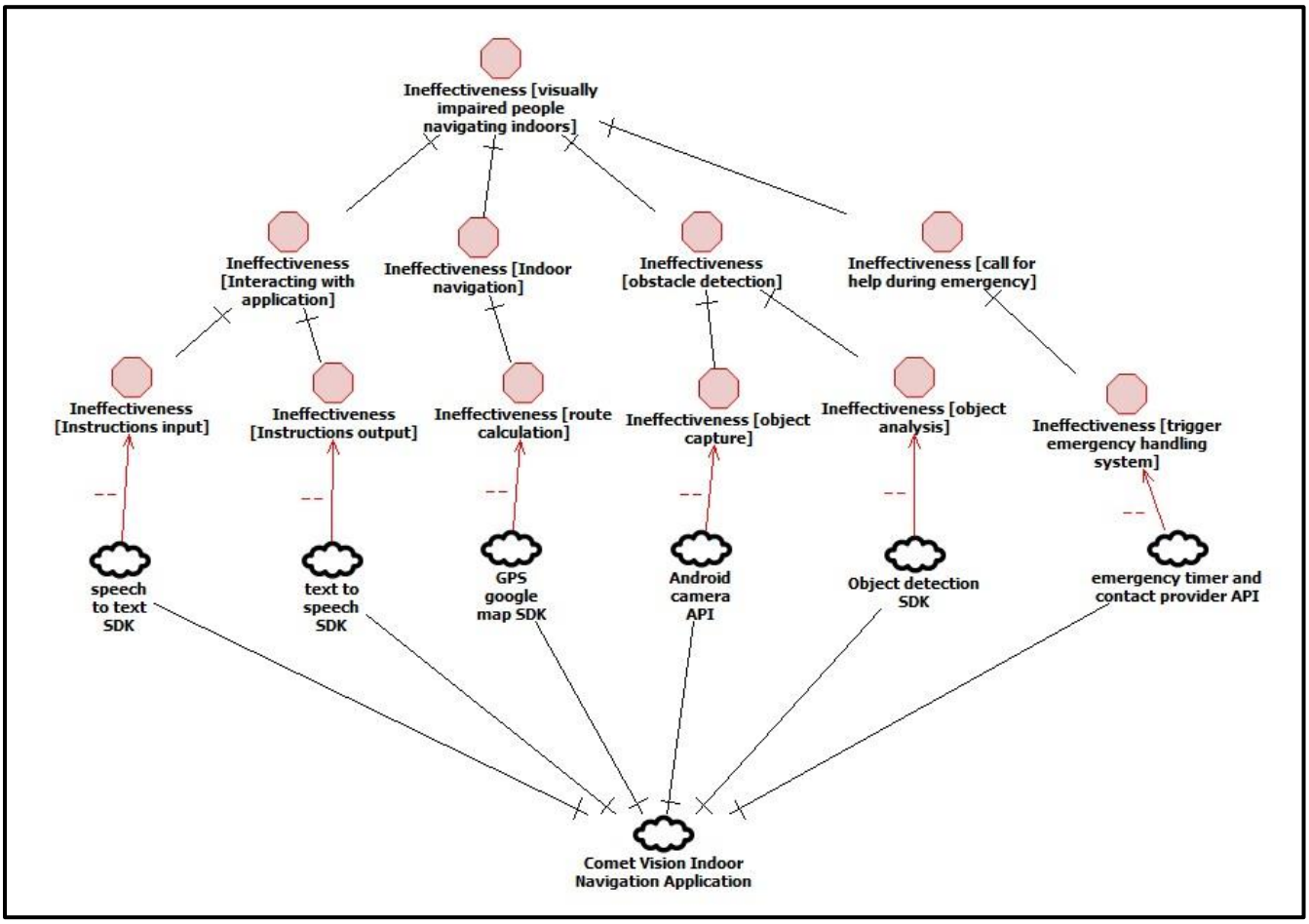


Figure 4. Problem Interdependency Graph of Comet-Vision

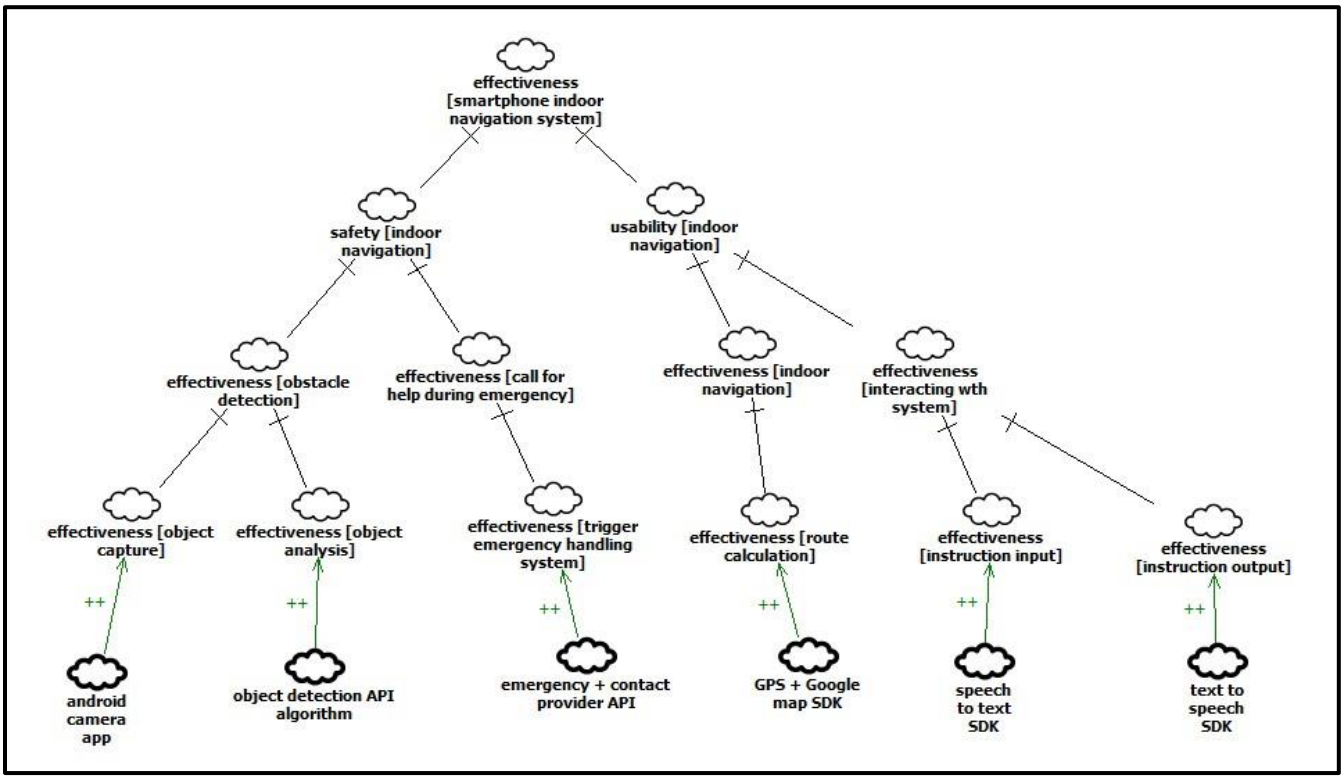


Figure 5. Soft-Goal Interdependency Graph of Comet Vision

4.2 Summary of Capabilities

Customer Benefit	Supporting Features
Users can use the application and have control over their own application without assistance.	Voice Commands
Users will quickly understand how to use the application with convenient and easy icons/buttons.	User-friendly UI
Users can quickly contact their trusted contact saved in the application or public emergency services (911, UTD Police, Office of Student AccessAbility, etc) whenever they need assistance.	Contacting emergency contact when needing assistance
Users will be able to enter their class schedule to set alarms accordingly to remind them of their next plans. It will also allow them to not miss their next class and arrive on time.	Adding class schedule and setting customized alarms
Users will be provided with a user manual via voice and text to quickly understand how to use the application.	Voice/Text instructions after installation

4.3 Assumptions and Dependencies

- It will be assumed that the users have, or have access to their own, individual Android device to install and run this application on.
- It will be assumed that the user can walk without assistance.
- It will be assumed that the visually impaired user can speak with or without a voice assistant.

- It will be assumed that the visually impaired user is able to perform functionalities including, but not limited to, unlocking the phone with or without an assistant.
- It will be assumed that the users and servers will possess decent internet connectivity since the whole process is based on a connection with a remote server.
- It will be assumed that the battery percentage of the user's device is enough to ensure the application is able to run during the whole navigation process.

4.4 Cost and Pricing

Software			
Component	**Justification**	**Quantity**	**Cost**
Android Studio	IDE for Android development.	6	$0.00
Gradle Build Tool	Automation tool for software development.	6	$0.00
Java SE Development Kit 8	Required for Java development.	6	$0.00
Software Total			$0.00
Other			
Component	**Justification**	**Quantity**	**Cost**
Google Play Registration Fee	Must be paid to publish an app.	1	$25.00
Other Total			$25.00
Overall Total			**$25.00**

4.5 Licensing and Installation

Licensing and installation instructions will be available on application release. The license will belong to the Comet-Vision team. The application will be available through the Google Play Store to be installed on Android devices.

5. Product Features

5.1 GPS Enabled Navigation

This feature helps the user use their own customized map to navigate to different tie-points(destinations). This feature is more focused on the administrator of the application, who can create custom maps, define different tie-points and set alerts. This will help the user navigate to different places with their GPS location being on track.

5.2 Voice Assisted App Navigation

This feature uses Gesture Navigation and Text-to-speech services to help the user navigate the application with ease.

6. Constraints

6.1 Usability

This system must be easy to understand and to use for the users. The usages of the system shall be clearly described as the instruction manual via both voice and text will be provided upon installation. Users and their assistants shall be able to understand how to use the app in under 10 minutes.

6.2 Safety

The system must calculate a safe route for the visually impaired users by detecting any obstacles in the way. The system must also avoid crowded areas with many people to decrease the chance of running into other people.

6.3 Privacy

The system must also adhere to the HIPAA (Health Insurance Portability and Accountability Act) rule to protect individuals' health information. It will protect important information such as medical records and other individually identifiable health information, health plans, and more.

6.4 Integrity

The system must guarantee and keep on supporting the integrity and consistency of data processed in the system to detect any corruption of information either deliberate or unintentional.

6.5 Responsive

The system must respond quickly to user requests or changes in the environment to provide the best experience for the users.

7. Quality Ranges

- The application must alert the user of an obstacle at least 30 meters from them so that the user can avoid it.
- This application must respond within 1 second to provide a fast user experience.
- This application must contact emergency contacts or emergency services such as 911, UTD police, etc., within a minute once user requests assistance. The system must automatically connect them to the call successfully.
- This application must contact emergency contacts or emergency services such as 911, UTD police, etc., within 5 seconds when it detects a fall, and the user cannot contact them directly.
- This application must correctly authorize the user when logging in using their credentials and finger ID.
- This application must correctly identify the room number of the users' destination to navigate to the right destination.

8. Precedence and Priority

1. This application must be deployed by the end of 2022
2. Maintenance cost of the application must not be greater than $5000 per year
3. This application must work in conjunction with third-party users to provide the required assistance the users may need
4. This application must correctly identify the obstacles and alert them in a clear, lucid way

9. Other Product Requirements

9.1 Applicable Standards

- The application must follow HIPAA policies
- The application must follow privacy guidelines of the UTD policies

9.2 System Requirements

- The cell phone must have Android platform version 7.0 or higher
- The sound volume of the mobile phone shall always be set according to the last setting done by the user
- The cell phone must have a camera, GPS capability, speakers, and a microphone

9.3 Performance Requirements

- Speech-to-text conversion shall take place within 10 seconds
- The system shall be able to detect the words spoken by the user at 60dB
- The speech-to-text converter shall be able to convert spoken word text within 70dB
- The essential data shall be transferred from the medical device to the Android phone between 10-30 seconds
- The output audio shall be without noise interference and be output within 1 second delay
- The speech-to-text converter shall correctly identify each word which is spoken 95% of the time

9.4 Environment Requirements

- The application must be able to navigate indoor rooms of the first floor of ECSS building at UTD
- The application must recognize the location of the room by the room number

10. Documentation Requirements

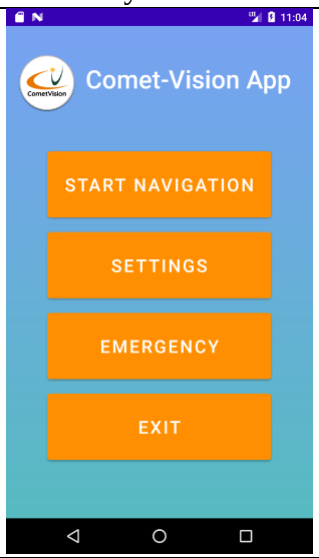
10.1 User Manual

1. Splash Screen Page

The first screen that opens when the user or the person assisting them opens the application is the Splash Screen Page.

+ Tracking the User

After successfully identifying themselves and logging in, the application will locate the user's current position and place a pointer on the application. If the app is unable to locate the user within a certain amount of time, it will contact the emergency contact of the user to ensure their safety.



2. Main Page

The user is read-out instruction listed on the Main Page by the application using TextToSpeech service. Then the user can perform specified hand gestures to navigate between activities inside the application.

Gestures & Action

- Swipe Right – Switch to Start Navigation Page
- Swipe Left – Switch to Settings Page
- Swipe Up – Contact Emergency Service
- Swipe Down – Exit Application

3a. Setting up the maps for admins

The system administrators can set up their maps and define their "tie points" in them. The Tie-points are the locations where a person would want to navigate to.

3b. Defining the tie-points

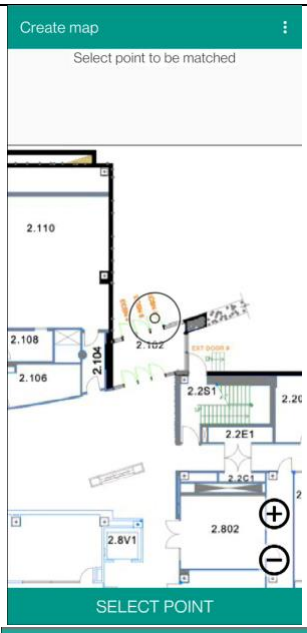
The system allows you to define the tie-point by augmenting your custom map on a real map. You can augment your tie-points depending upon your needs in the google maps and set the GPS ball point.

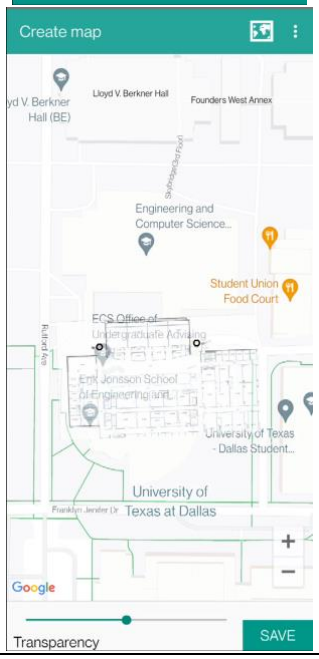
3c. Augmenting your custom map

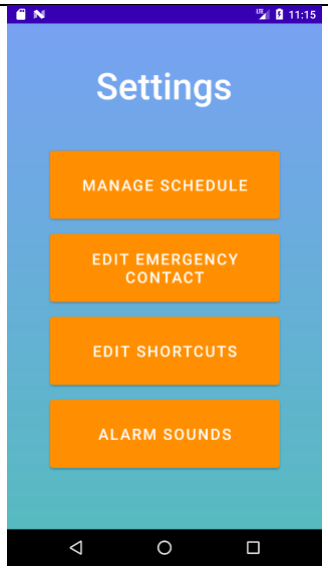
The system allows you to augment your entire map on a google map, set the location and GPS reset for initial setup. It will then detect your movement and keep updating your GPS values accordingly. It keeps track of Longitude, Latitude, Altitude, Differential movement, Speed and Accuracy.

3b. Ending Navigation Screen

Once the user reaches their destination, the device will vibrate again to let the user know that they've reached their destination. If the user needs to take a detour or stop somewhere in the middle of their route, they can once again use the voice command and let the application know where they want to go or stop by.


Create map
Select point to be matched
2.110
2.108
2.106
2.104
2.102
2.2S1
2.2E1
2.2C1
2.802
2.8V1
SELECT POINT


Create map
Lloyd V. Berkner Hall
Founders West Annex
Engineering and Computer Science...
Student Union Food Court
ECS Office of Undergraduate Advising
Erik Jonsson School of Engineering and...
University of Texas - Dallas Student...
University of Texas at Dallas
Google
Transparency
SAVE



4. Settings Page

The settings page includes a few options:

a) Manage Schedule

The user can add or remove their class schedules on the application so that the application can send out alarm notifications when it is time for their next class. This will allow the application to take the user to their needed destination without the user manually starting the app every time. It will also help the users if they forget or are preoccupied with something else. They will also have the option to edit their personal schedules and add new destinations whenever they want to.

b) Edit Emergency Contact

The user can add or edit their emergency contact information to contact when they are in danger or in need of assistance. However, the default emergency contact information like 9-1-1 or other resources will always be saved in the application.

c) Edit Shortcuts

This allows the users or the assisting person to put preferences regarding their routes along with some shortcuts that the user often takes on the main page if they wish to do so.

d) Alarm Sounds

If the user is not comfortable with the vibration option, the user can choose some other alert sounds that they wish to for customization.

+ Connecting to an Emergency Contact

This screen is an example of what the application will look like once it is automatically connected to Emergency Services in an emergency.

10.2 Installation Guides

1. On your device, go to the Apps section and tap Google Play Store.
2. The app will open, and you can search for “Comet-Vision” application.
3. Select “Comet-Vision”.
4. Select **Install**.
5. Follow the on-screen instructions to complete the installation of “Comet-Vision”.

10.3 Configuration

The Application must allow Google play services, location and phone usage. These are the most important permissions required by the application.