

CptS 484: Software Requirements

WRS Document

Requirements Elicitation - Team Auriel - 10/17/2021

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Revision History

Date	Version	Changes	Editor
Oct 1	V0.1	Framework	All
Oct 10	V0.5	Adding Issues and Introduction	All
Oct 15	V1.0	Adding WRS	All
Oct 17	V1.1	User Manual and Mockups	All
Dec 1	V2.0	Created for ph II	All
Dec 5	V2.1	Added KAOS models for goals	David
Dec 8	V2.2	Added Hipaa Non-Functional Req 5, NFR1 5	Akshaya
Dec 9	V2.3	Refine NFR5	David
Dec 9	V2.4	Added IDEFO Diagram	Pallavi
Dec 9	V2.5	Filled in Satisfied by prototype feature	Yinan
Dec 10	V2.6	Added KAOS models for Responsibilities and Obstacles	David
Dec 10	V2.7	Added KAOS models for Issues	All

[1] Introduction

1.1.Purpose

With the popularity of mobile phones, the development of mobile .Internet and related navigation technologies, navigation through apps has greatly facilitated our daily travel and has become an essential part of our daily travel. Due to congenital visual defects, blind people are unable to perceive and find information about public facilities and apartments around them, let alone further plan the relevant routes. Even if you have been there before, it is extremely difficult to travel independently to reach relevant locations. In addition, the number of guide dogs for the blind is few and it is difficult to train them to help ordinary people with vision defects. Some other special hardware devices also have the disadvantages of additional hardware purchase, poor effect and inability to use existing map data to inform people of the surrounding facilities, businesses and other information. Therefore, our purpose is to help blind people travel in daily life through simple operation interface, voice broadcast, mobile APP and other means combined with current information technology.

The purpose of this software requirement analysis report is to provide a business requirement goal of the development system determined by users and developers, and to describe the related functions in detail. Based on the demand analysis of blind navigation, it becomes the technical basis of software development.

This software requirements analysis report is intended for software customers, software requirements analysts, software designers and developers, and related testers.

The Goals, Responsibility and Obstacles were modeled using the Objectiver 3.0 tool. One model was done with Drawio (diagrams.net) due to limits of the free license of Objectiver.

1.2.Scope

Auriel is the name of the project which is planned to be developed by our team. The system will include two interconnected parts which will be run concurrently. These parts are Navigation and Voice Recognition. They will wait commands from the user at the same time and be triggered if the command taken concerns them. For the use of non-blind people a user interface will be provided and all commands regarding these components will be obtained from this interface.

1.3.Objectives and Success Criteria

The aim of the system is not to design a guide for all aspects of blind people's lives. Instead, it is focused on specific aspects which are thought to be essential by the team. In addition to its core features, the application will include several minor functionalities. For example, the application will be able to send messages to the relatives of the blind people. These minor and major functionalities are expressed in detail in the section of Specific Requirements.

There will be several options related to each component of the project. When the user intends any change in these options inside the application, these changes will not be controlled by developers or any

third party users or people. The system does not contain any parts of the server client architecture. Moreover, there will be no admin on top of the application. The user of the application will be able to change his/her options provided that it does not create conflicts with the statements in the Constraints section.

As stated before, the main goal of this project is to develop an application mostly for the use of blind people and to get them involved in the smartphone environment.

1.4.Definitions, Acronyms, and Abbreviations

System: the mobile application and all dependencies, including the APIs it uses, sensors, and devices it is connected to in a building or through the internet.

GUI: Graphical User Interfaces.

Android: Open source mobile operating system developed by Google

IOS: A mobile operating system developed by Apple

POI: Point of Interest. In gis, a POI can be a house, a scenic spot, a post box, a bus stop, etc.

RSSI: Received Signal Strength Indication.

OS: Operating System

1.5.Overview

The first section in this document gives an introduction with respect to the purpose, scope, objectives, definitions, and acronyms used in the rest of the document. Lastly, this first section gives an overview of what to expect in the rest of the document. In the second section, the preliminary definition will be discussed. In the third section, the issues found in the preliminary definition for the Auriel project will be identified, options for resolution raised, and the decisions taken will be enumerated along with the rationale for such decisions. In the fourth section, the team's improved understanding of the PRD will be given. The fifth and sixth section gives details of prototyping work done so far, while the seventh section gives a user manual for this application. The eighth section talks about traceability among the various levels of requirements identified. The ninth section gives a list of references that have been used in drawing up this document.

[2] Preliminary Definition

2.0 Technical Feasibility

To address Technical feasibility we first will create a prototype that will run on a phone. The code will be done in HTML, JavaScript, CSS and Angular. We will use the Sensor Web API's to talk to the Accelerometer, AmbientLightSensor, GravitySensor, Gyroscope, LinearAccelerationSensor, Magnetometer, OrientationSensor, and RelativeOrientationSensor. These Sensors will help in providing accurate data to the user when navigating using Auriel.

Technical Activities

- Test for technical feasibility
- Identify potential safety and environmental hazards. Test if the app responds to obstacles and keeps the user safe.
- Create a preliminary production feasibility assessment by running the app in a building before general availability (GA).

2.1. Preliminary Domain, Stakeholders Functional and Non-Functional Objectives

ID	Preliminary Domain and Stakeholder Description
PD0	The system shall be used by a blind or visually impaired person who can hear and speak clearly.
PD1	The domain of the user shall remain indoors -which can consist of multiple floors, each of which possibly hosts multiple classrooms, offices, bathrooms, lounges, elevators,
PD2	A family member or assistive person – will set the configuration of the app
PD4	The system shall use as many sensors that are available on an advanced smartphone
FO1	Navigating indoors
FO2	Going from one location to another
FO3	Going from one building to another
NFO1	The system shall provide the user safe navigation
NFO2	The system shall provide users with fast navigation

NFO3	The system shall provide the users with comfortable navigation
NFO4	Usability or user-friendliness
NFO5	Using voice recognition

2.2.Preliminary Functional Requirements

PNFR_ID	Preliminary NFR Description
PFR1	Accepting from the user the destination location to go
PFR2	Figuring out the routes to reach the destination
PFR3	Telling the user to walk a distance
PFR4	Telling the user to stop at the right place to turn
PFR5	Detecting obstacles and telling the user what to do in order to avoid a collision
PFR6	Placing emergency calls and messages, possibly after detecting a fall or when the system has lost its current location.
PFR7	Figuring out what the next action(s) would be, based on the user's schedule or habit, and suggesting/accepting the user's choice

2.3.Preliminary Non-Functional Requirements

PNFR_ID	Preliminary NFR Description
PNFR1	The system shall help the user safely navigate indoors
PNFR2	The system shall lead the user through the fastest route.
PNFR3	The system shall lead the user through the route that the user would feel the most comfortable with
PNFR4	The system shall be usable for blind people.
PNFR5	The system shall be ubiquitous.
PNFR6	The system shall be customizable to every user: e.g. volume, the interval of instructions, etc.
PNFR7	The system shall be easily extensible to accommodate the following typical variations: variations in interface, language, definitive needs of the user, new features, new sensors and hardware, etc.

[3] Issues with the Preliminary Definition Given

3.1.Domain, Stakeholders, Functional, and Non-Functional Objectives Issues

Domain Issue ID	Domain Issue Description	
DI1	PD1	The <i>domain</i> will be indoors
	1. Ambiguous and Incomplete: Indoors is described in the preliminary definition as consisting of multiple floors, each of which possibly hosts multiple classrooms, offices, bathrooms, lounges, elevators. However, we do not have a definition of how many buildings there are and how we address newly added buildings	
	Option 1	The system prerequisites a particular way to model each building and the model of the building can be uploaded to the storage servers through separate APIs by building configuration managers. It also includes additional information about number of rooms, room names, beacon locations etc
	Option 2	Every new building will be automatically modelled
	Option 3	The assistive person inputs the building information and model
	Choice	Option 1
	Rationale	Option 1 is most suitable since, it makes the system's tie to users more decoupled and from the perspective of the blind user - there is no change in the way they use the system
Revised wording		3.1.8.1

Domain Issue ID	Domain Issue Description
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DI2	PD2	A family member – who sets the configuration of the app
	2. Ambiguous: The configuration of the app doesn't clearly capture what the assistive person will do. It could mean multiple things.	
	Option 1	Consider that configuration includes setting the language of instruction and input of the app, speed at which the app gives out instructions, and app tracking user information.
	Option 2	Consider that each building has a different configuration and when the blind person enters a building there will always be an assistant who will set the configuration. This includes information like if all the elevators are functional in the building etc.
	Option 3	Consider configuration means setting up of the app, the assistive person is involved primarily during the setup of the app when the user is getting familiar with the features. The assistive person can also input their details to be contacted in case of emergencies
	Choice	Option 3
	Rationale	The system is designed such that Option 1 can be handled by the blind user and Option 2 is handled by the System. Option 3 makes the need for the assistive person clear and ensures that the setup of the app is accurate as the correct working of the app depends on it
Revised wording		3.1.8.1

Domain Issue ID	Domain Issue Description	
DI2	PD3	The users will be provided safe navigation
	1. Ambiguous and Incomplete: There is no clear definition of what exactly safe means? The safety of the user can be threatened by	

	several factors and what they are is not captures in the preliminary definition	
	Option 1	Consider that safe navigation includes detecting obstacles using the user's phone sensors and helping them avoid a collision and also alerting the user to slow down in case they are moving at a pace that collision detection can not keep up with.
	Option 2	Consider that safe navigation tells the user to stop if the connection to the user's phone is lost.
	Option 3	Safe navigation includes alerting the user that they have taken a wrong turn or going in a direction different from the one suggested by the application.
	Option 4	Consider that safety includes all the features mentioned in options 1,2 and 3 above.
	Choice	Option 4
	Rationale	Option four provides the highest level of safety to the user as it considers all the parameters that may threaten the safety of the user.
Revised wording		3.1.8.1

Domain Issue ID	Domain Issue Description	
DI3	PD4	The system shall provide users with fast navigation
	2. Ambiguous and Incomplete: There is no clear definition of what exactly fast means? Fast can also depend on how fast the user chooses to walk on a given day, crowd in the building etc	
	Option 1	Consider that fast navigation includes choosing the shortest path to the user's destination
	Option 2	Consider the definition of fast to mean that the app takes very less time to return the path.
	Option 3	Fast also could mean that the app announces the instructions in a simple and easy to understand way so that users can immediately take action

	Choice	Option 3 and 1
	Rationale	It is in the best interest of the user if the app announces the instructions using the simplest language possible and chooses the shortest path to the destination
Revised wording		3.1.8.1

Domain Issue ID	Domain Issue Description	
DI4	PD5	The system shall provide the users with comfortable navigation
	3. Ambiguous and Incomplete: There is no clear definition of what comfortable means in this context.	
	Option 1	Consider that comfortable navigation means navigating the user along a path where they expend less physical effort, i.e., elevators and escalators over staircases, fewer stairs.
	Option 2	Consider that comfortable navigation means navigating the user along a path with fewer obstacles or people.
	Option 3	Consider that comfortable navigation is a functionality of the app to provide the user's preferred path on their previously-traveled paths.
	Choice	Option 2 and 1
	Rationale	Considering option 3 means that the app is always tracking where the user is going or the paths that they are taking and the app does not perform this tracking. Thus comfortable navigation refers to avoiding obstacles and having the user take a minimum number of steps.
Revised wording		3.1.8.1

Domain Issue ID	Domain Issue Description	
DI5	PD6	The system shall use as many sensors that are available on an advanced smartphone
	4. Ambiguous and Missing information: Advanced smartphone's definition can change day to day and new sensors are being invented and added to smartphones very often and so it is important to define what it means.	
	Option 1	Consider that advanced smartphones are running the latest versions of the android and iOS operating systems
	Option 2	Consider that the advanced smartphones have all the necessary sensors that the app will need for the correct functioning of the app including the proximity sensors, accelerometer, motion sensors and the OS version that can run the application
	Option 3	Consider that an advanced smartphone has all the advanced features that are available currently
	Choice	Option 2
	Rationale	A user may not always be able to afford and have a phone that has all the advanced sensors. The user can not also keep updating their phones every time there is a new sensor or software update released. Also, it is a fact that the currently available smartphones (as of October 2021) have all the sensors mentioned in option 2 and the future models with the same sensors.
Revised wording		3.1.8.1

3.2. Functional Requirements Issues

FR Issue ID	Description	
FRI1	PFR1	PFR1. Accepting from the user the destination

	1. 1. Incomplete: How does the user specify “Accepting from the user the destination location to go”?	
	Option 1	We could use a dropdown list of previously run routes.
	Option 2	We could use voice commands and then interpret the users desired destination
	Option 3	The app can read all of the previous routes that have been taken and ask the user to pick one. If no previous routes exist, use option 2.
	Choice	Option 3
	Rationale	Option 3 was chosen for ease of use and clarity for the user
Satisfied by	FR1	

FR Issue ID	Description	
FR12	PFR2	Emergency calls
	1. Incomplete: Emergency needs to be more defined and detailed. Does the app always call 911 or should it be more precise and do some work to try to notify the user?	
	Option 1	If a user falls or the user loses connection, ask a question to the user if they need help. If the answer is yes or no answer then the first to call would be the caretaker. If the caretaker does not respond after 6 rings, then call the backup caretaker. If that does not succeed, call 911.
	Option 2	Always call 911 no matter what.
	Option 3	Always call 911 and the caretaker.
	Choice	Only the caretaker is called.
	Rationale	We choose the option I for the most thorough safety measures.
Satisfied by	FR2	

FR Issue ID	Description	
FRI3	PFR3	Detecting obstacles
	1. Incomplete: Detecting obstacles and telling the user what to do in order to avoid a collision.	
	Option 1	Tell the user to stop and walk around the obstacle.
	Option 2	Tell the user to stop, and go left or right around the obstacle.
	Option 3	Tell the user to slow down and use caution while walking.
	Choice	Option 2
	Rationale	We chose option 2 to guide the user with the most information.
Satisfied by	FR3	

FR Issue ID	Description	
FRI4	PRF4	User to walk a distance
	1. Incomplete: Telling the user to walk a distance (e.g., 2 minutes before turning, or walk for 30 steps, etc.)	
	Option 1	Tell the user to walk a number of steps
	Option 2	Tell the user to walk a number of minutes
	Option 3	Tell the user to walk a number of steps before turning
	Choice	Option 3
	Rationale	We use steps since we have recorded the step size in the configuration and then we tell the user to turn left or right.
Satisfied by	FR4	

FR Issue ID	Description	
FR15	PFR5	Figuring out the routes to reach the destination
	1. Incomplete: The routes need to be sorted by either speed or safety.	
	Option 1	Sort the routes by safety, i.e. the elevator is safer than the stairs. The user will choose.
	Option 2	Always use the safest routes
	Option 3	Always use the fastest routes
	Choice	Option 1
	Rationale	The user will have a choice but we sort on a safety parameter (1-10).
Satisfied by	FR5	

FR Issue ID	Description	
FR16	PFR6	Figuring out what the next action(s) would be, based on the user's schedule
	1. Incomplete: The user's schedule is not defined	
	Option 1	Download the user's schedule from the administrator
	Option 2	Allow the user/caretaker to enter the schedule manually
	Option 3	Record each navigation session as a complete schedule and then list the previous routes they have taken.
	Choice	Option 3
	Rationale	We chose to record each navigation session and list them for the user to select at the start of the navigation
Satisfied by	FR6	

FR Issues ID	Description	
FRI7	-	The system shall know the user's usual routes by tracking
	Missing: This requirement has not been addressed in the preliminary definition.	
	Option1	The app asks the user permission to track their movement. If they allow, it will store their usual schedule and make route suggestions based on that or it simply calculates the currently available route
	Option2	The app always tracks where the user is moving
	Option3	The app never tracks their usual routes and only answers based on currently available routes
	Choice	1
	Rationale	Option 1 is best because it leaves the choice to the user to decide whether they wished to be tracked or not.
Satisfied by	FR 7	

FR Issues ID	Description	
FRI8	-	The user's smartphone may run out of battery.
	Missing: This requirement has not been addressed in the preliminary definition.	
	Option1	The app detects when the battery level is at 20%, alerts the user that battery is low, asks the user if they want to notify the assistive person when the phone dies and/or hear all remaining instructions at once.

	Option2	The app notifies the assistive person instantly when the battery is below 20%
	Option3	The app narrates all instructions at once.
	Choice	1
	Rationale	Option 1 is best because it leaves the choice to the user to decide whether they wish to notify the assistive person. They can also choose to know all instructions at once and also alert the assistive person
Satisfied by	FR 9	

FR Issues ID	Description	
FRI9	-	The app has a way to alert the user's assistive person
	Missing: This requirement has not been addressed in the preliminary definition.	
	Option1	The get help button can be used by the user to call the assistive person, at any time during the navigation.
	Option2	The app alerts the assistive person only when an emergency has occurred
	Choice	1
	Rationale	Option 1 is best because it allows the user to
Satisfied by	NFR 6	

3.3.Non-Functional Requirements(NFR) Issues

NFR Issues ID	Description	
NFRI1	PNFR_1	The system shall help the user safely navigate indoors.

	Incomplete and unclear: How and what safety measures are being taken?	
	Option1	Alert the users when they approach stationary and constant objects like trash cans.
	Option2	Provide alternate routes to the destination with a lesser number of obstacles.
	Option3	Press a button to alert caretakers to help the user reach their destination.
	Choice	1
	Rationale	Option 1 seems more sensible and effective in order for the user to navigate safely.
Satisfied by	NFR1	

NFR Issues ID	Description	
NFR12	PNFR_2	<ol style="list-style-type: none"> 1. The system shall help the user safely navigate indoors. 2. The system shall lead the user through the fastest route. 3. The system shall lead the user through the route that the user would feel the most comfortable with.
	Incomplete: How do we choose between the 3 options to ensure the person reaches the destination safely and comfortably?	
	Option1	Determine the route based on a person's comfort first, then safety, and then the fastest.
	Option2	Determine route based on the person's speed in order to take the fastest route.
	Option3	Determine route based on safety and then based on how fast it can be reached.
	Choice	1

	Rationale	Option 1 could be more practical if the user is already familiar with the route, then there are fewer chances of them hitting an obstacle.
Satisfied by	NFR2	

NFR Issues ID	Description	
NFR13	PNFR_3	The system shall be customizable to every user: e.g. volume, the interval of instructions, etc.
	Incomplete: How many customizations and what kind of customizations are we providing to the customers?	
	Option1	Providing common languages so the user can use the language he/she is comfortable with.
	Option2	Interval of instructions
	Option3	Volume range
	Choice	1, 2 and 3
	Rationale	Providing the maximum sets of customizations for the users would make them use the application even more and also help them navigate safely.
Satisfied by	NFR6	

NFR Issues ID	Description	
NFR14	PNFR_4	The system shall be easily extensible to accommodate the following typical variations: variations in interface, language, definitive needs of the user, new features, new sensors and hardware, etc.

	Incomplete: By extensible does it mean we need to code the extensions?	
	Option1	Provide a basic set of extensions like interface, language for the user to select.
	Option2	Fix proximity and motion sensors along hallways of the building and recognize when the user passes by it.
	Choice	1
	Rationale	Option 1 seems more feasible than option 2. Option 2 may require high expenses due to placement of multiple sensors across the building.
Satisfied by	NFR7	

NFR Issues ID	Description	
NFR15	PNFR_5	The system shall be ubiquitous.
	Incomplete: What does the statement “Ubiquitous” mean in terms of the system?	
	Option1	Mobility
	Option2	Heterogeneity
	Option3	Scalability
	Choice	1
	Rationale	Mobility is preferred as the system needs to be present and available even on the move.
Satisfied by	NFR 5	

NFR Issues ID	Description	
NFR16	PNFR_6	The system shall be HIPAA Compliant.
	Missing : the preliminary definition does not take into account the HIPAA compliance norms	
	Option1	Provide a disclaimer that the app is not HIPAA compliant
	Option2	Address the main components of HIPAA compliance including - User Authorization, creating a remediation plan document and emergency planing.
	Option3	Create a HIPAA compliance checklist and address every item on it in addition to compliance with all items mentioned in Option2. This means that the system has authorization monitoring, saves data backup and gets HIPAA Compliance software certification from the federal body called Office of Civil Rights.
	Choice	3
	Rationale	Getting HIPAA certified is the most secure option for any application that deals with health, wellness or emergency related data.
Satisfied by	NFR 5	

[4] WRS

4.1.W

4.1.1. Problem

Problem ID	Problem Description	Corresponding Goals
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P1	It's hard for blind people to decide which direction they are heading.	G1, G2
P2	Blind people are not able to know the obstacle especially indoors.	G1
P3	When an emergency happens, people with visual disturbance will have less ability to handle it.	G3, G4
P4	Many devices the blind people use for daily traveling are expensive.	G5
P5	Web apps are too slow to keep up with the user.	G6

4.1.2. Goals

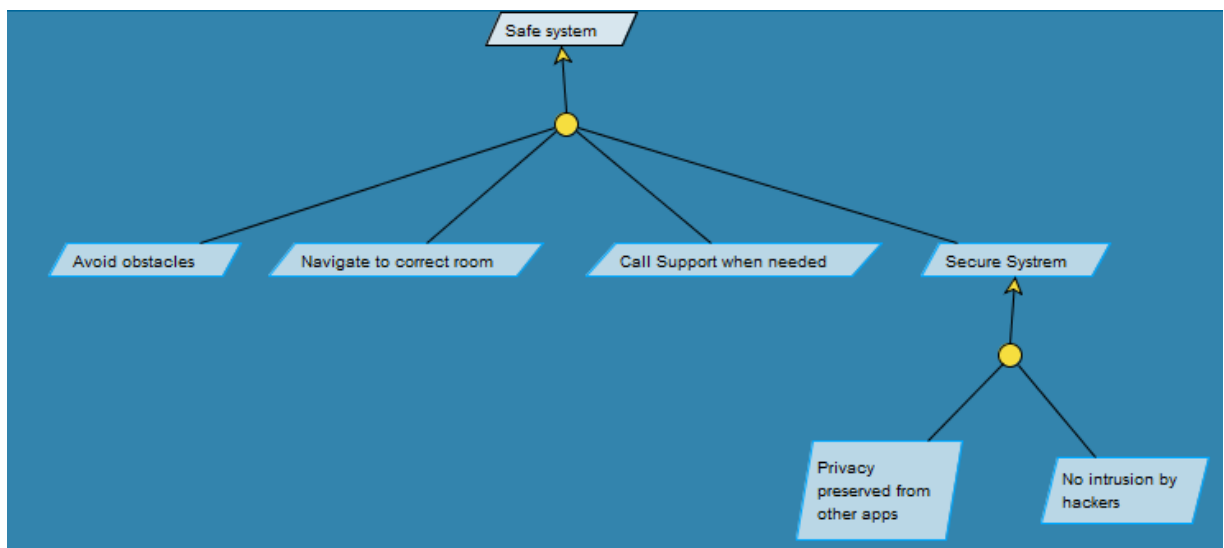


Figure 1. Goals for Safe System

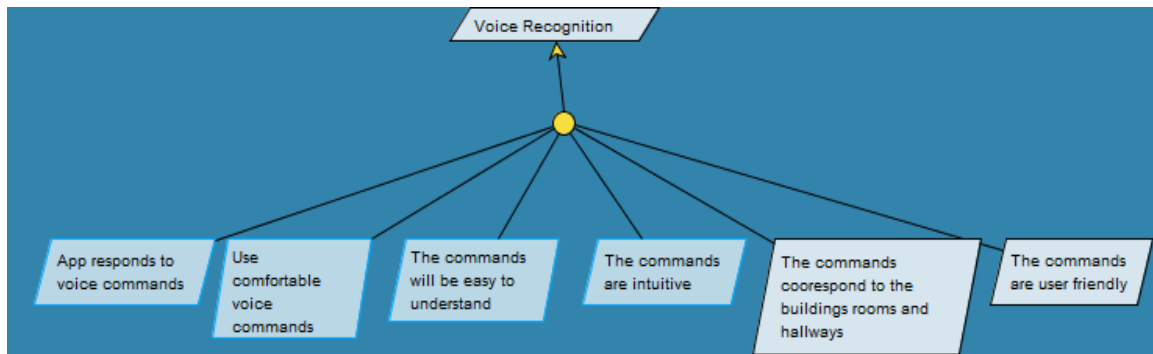


Figure 2. Goals for Voice Recognition

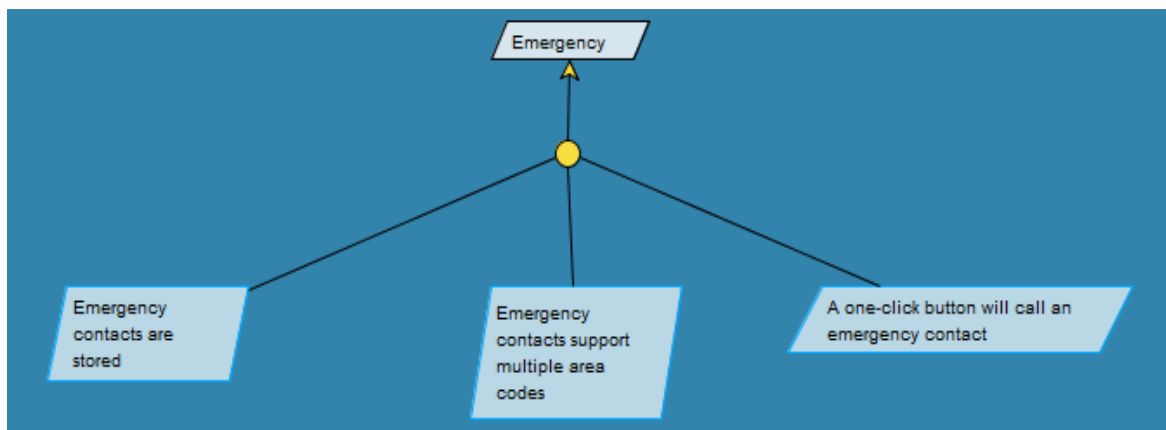


Figure 3. Goals for Emergency

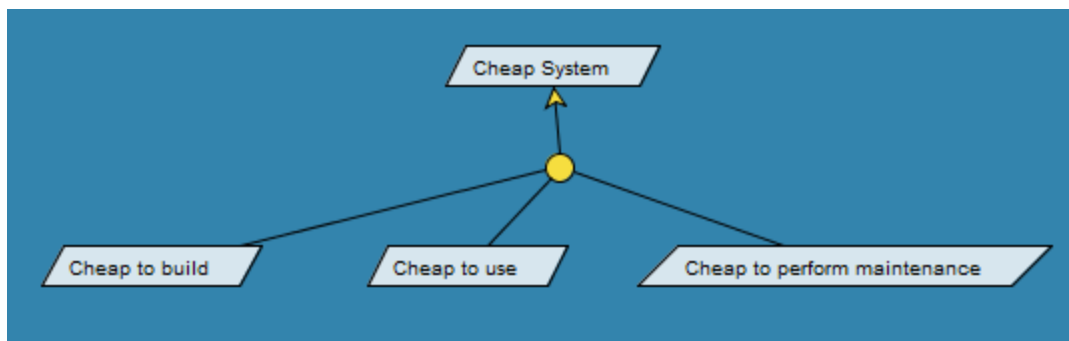


Figure 4. Goals for Cheap System

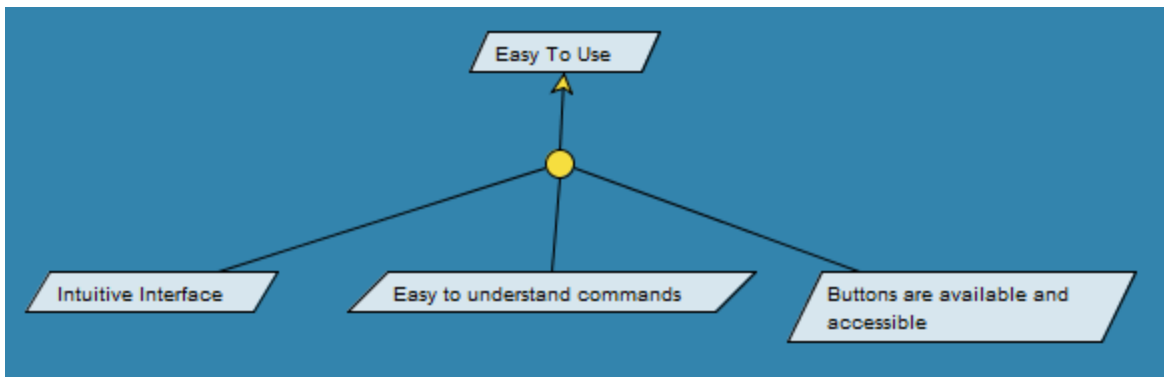


Figure 5. Goals for Easy System

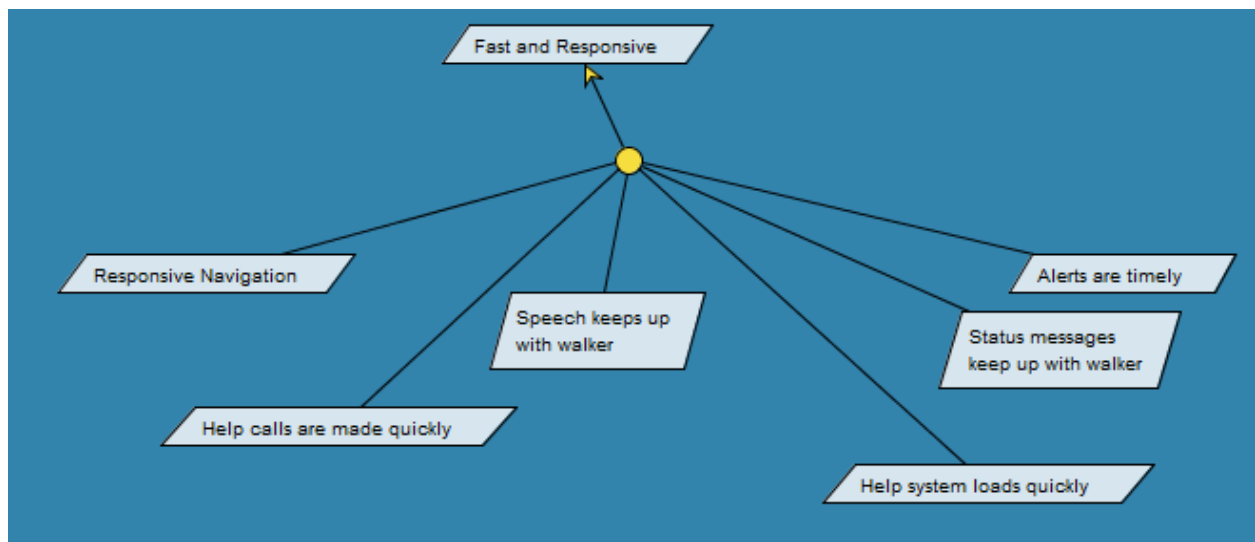


Figure 6. Goals for Fast and Responsive

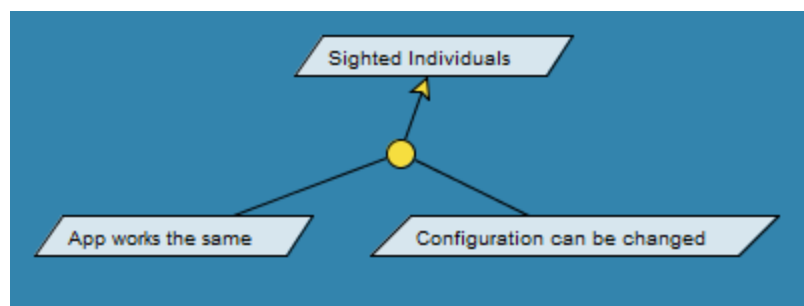


Figure 7. Goals for Sighted Individuals

Goal ID	Goal Description	Backward Traceability	Forward Traceability
G1	Help blind people travel in daily life safely through a navigation system inside a building	P1	FO1
G2	Provide a voice recognition function to help blind use the system conveniently.	P1	FO1
G3	When emergencies happen, the system could contact the relevant authorities as soon as possible.	P1	FO1
G4	It is also useful for those people who are not in vision disorder.	P1	FO1
G5	The application is cheap and easy to use for blind people.	P2	FO1
G6	The app is fast and responsive		FO1

4.1.3. Improved Understanding of Domain, Stakeholders, Functional, and Non-Functional Objectives

4.1.3.1. Improved Domain

Improved Domain ID	Improved Domain Description
ID1	<p>The application needs to be configured in mobile phone, which contains several essential sensors:</p> <ul style="list-style-type: none"> a. Magnetic field sensor b. Bluetooth or wifi positioning function c. Proximity sensor

	<ul style="list-style-type: none"> d. Accelerometer e. Motion sensor
ID2	<p>The Auriel application should be used by blind people need to travel in the following locations with multiple floors:</p> <ul style="list-style-type: none"> a. In a school b. In a hospital c. In an apartment d. In a care center for the blind

4.1.3.2. Stakeholders

The Auriel application shall be used by assistive person along with the blind person, building caretaker/managers in the following ways:

- a. Help blind people to set up the maps
- b. Help blind people to set up POI
- c. Set up voice recognition function for blind people
- d. Store his/her contact information and setup as the emergency contact
- e. Help blind people to set up account and password

The other stakeholders of the application are the developers/engineers who are the creators of this document, Dr.Bolong Zeng who develop / review the application.

4.1.3.3. Improved Functional Objectives

Improved NFR Objective ID	Objective Description	Alleviates Problem	Achieves Goal
INFRO1	Navigating indoors means that the app will only go to rooms and not inside a room.	P1	G1
INFRO2	The app will take the user from room to room	P2	G1
INFRO3	The app will take you to another building that is connected	P2	G1

4.1.3.4. Improved Non-Functional Objectives

Improved NFR Objective ID	Objective Description	Alleviates Problem	Achieves Goal
INFRO1	The app will use safe navigation by alerting users of obstacles such as pillars, walls and calling support staff when the user falls.	P1	G1, G2, G3
INFRO2	The app will have a fast responsive UI to keep up with users walking speed.	P5	G6
INFRO3	The app will use comfortable navigation with clear voice commands.	P1	G2, G5
INFRO4	The app is intuitive and user friendly	P1	G1
INFRO5	The app uses voice commands that correspond to the buildings rooms and hallways	P1, P2	G2

4.2.RS

Responsibility Models

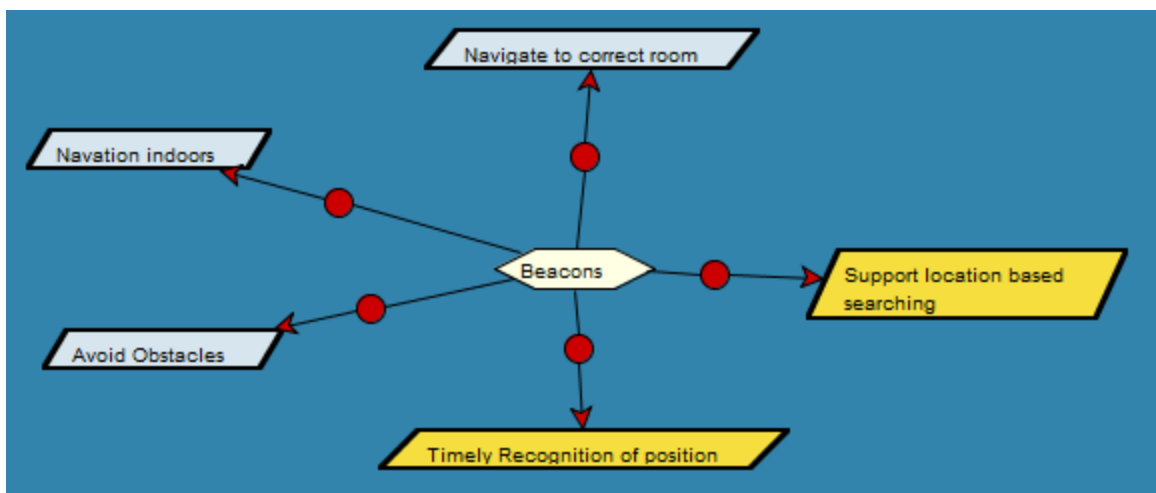


Figure 8. Responsibilities of Beacons

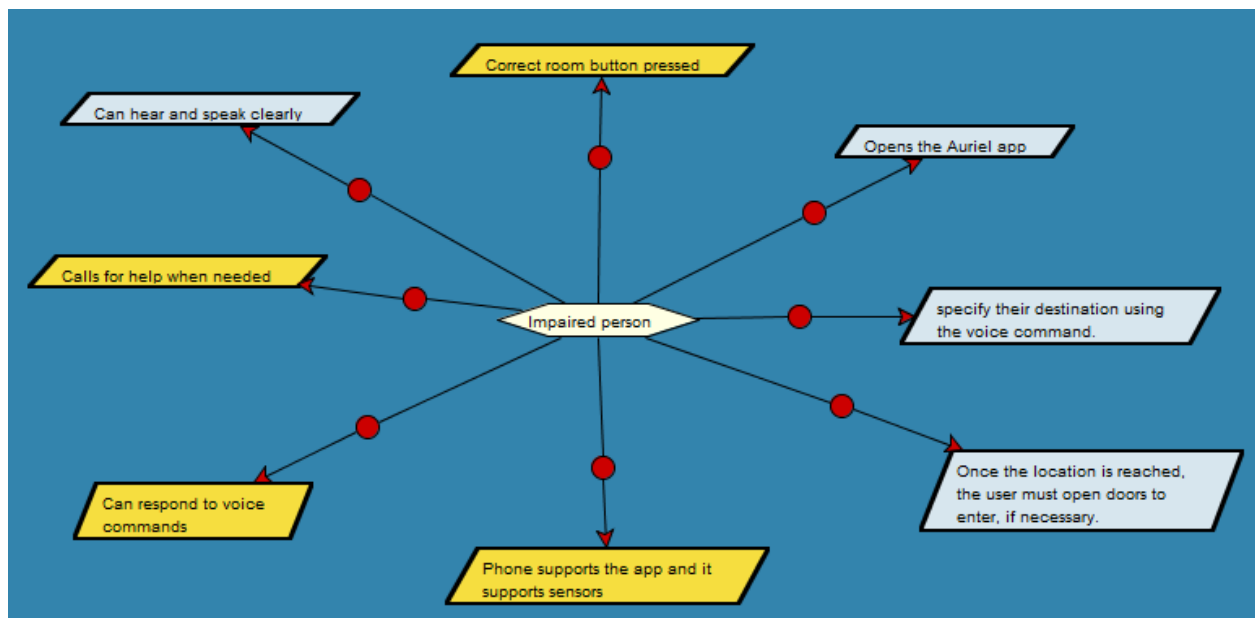


Figure 9. Responsibilities of Impaired person

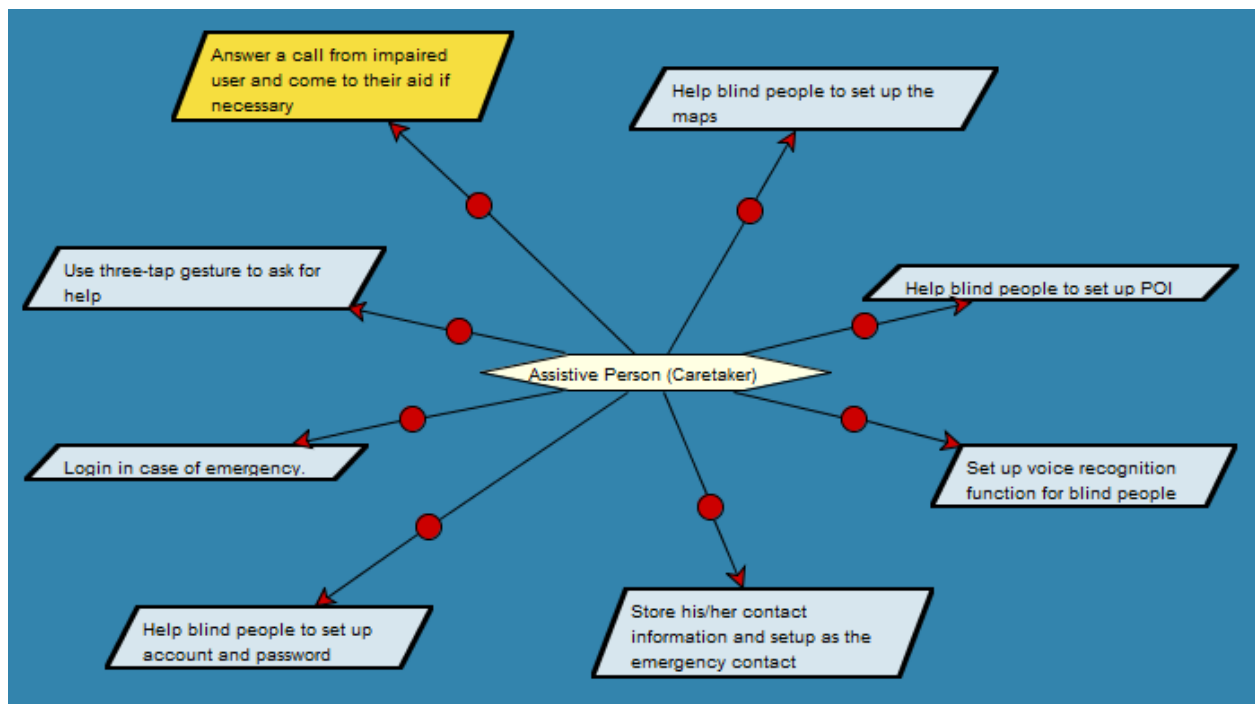


Figure 10. Responsibilities of Assistive Person

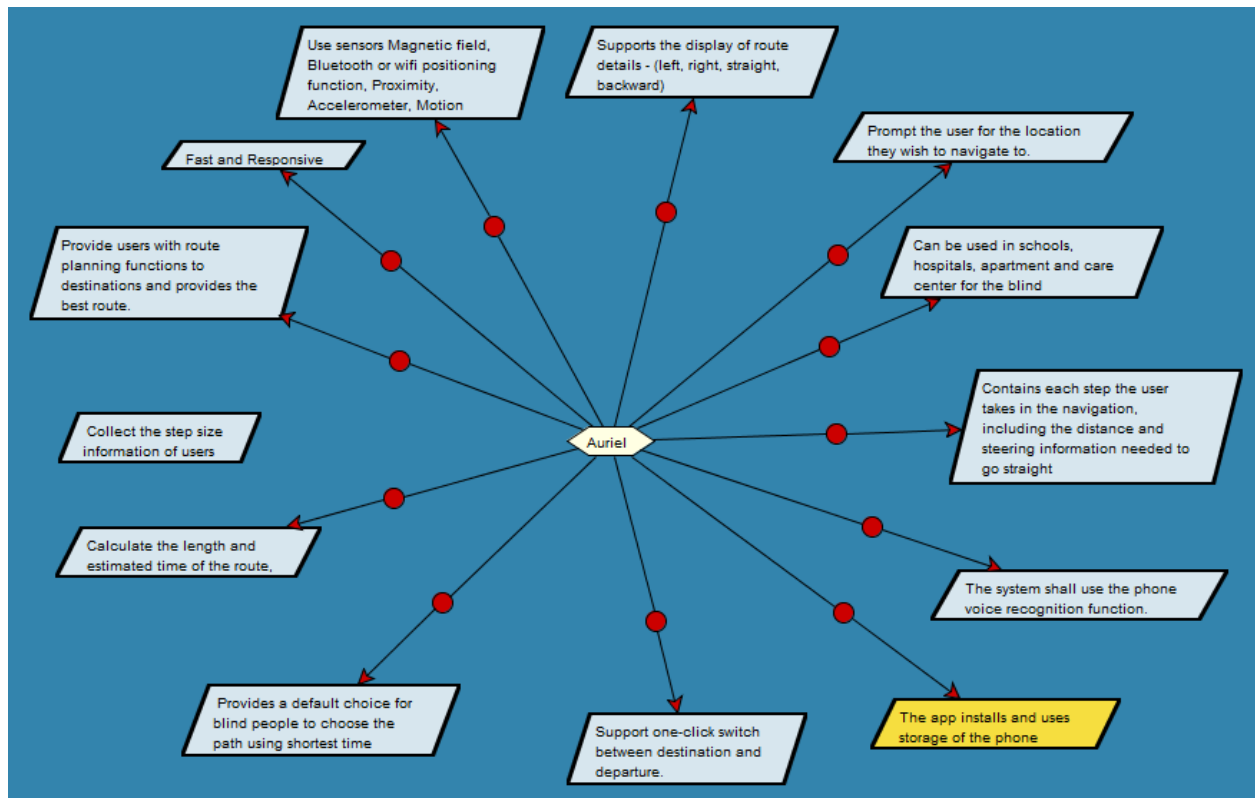


Figure 10. Responsibilities of Auriel

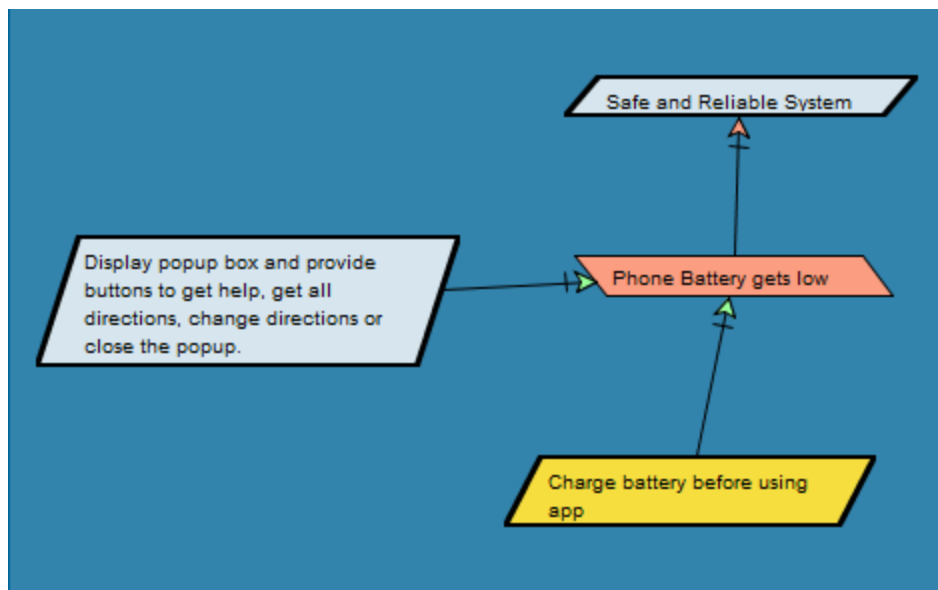


Figure 11. Obstacle of low battery

Issues Models

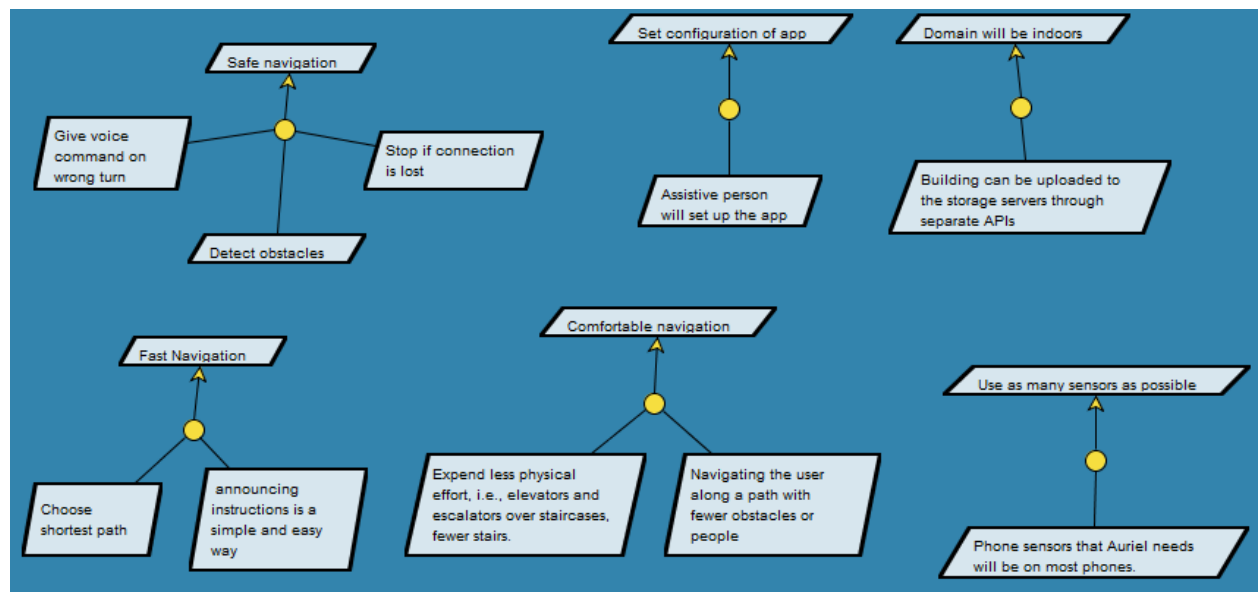


Figure 12. Domain Issues Solved by Requirements

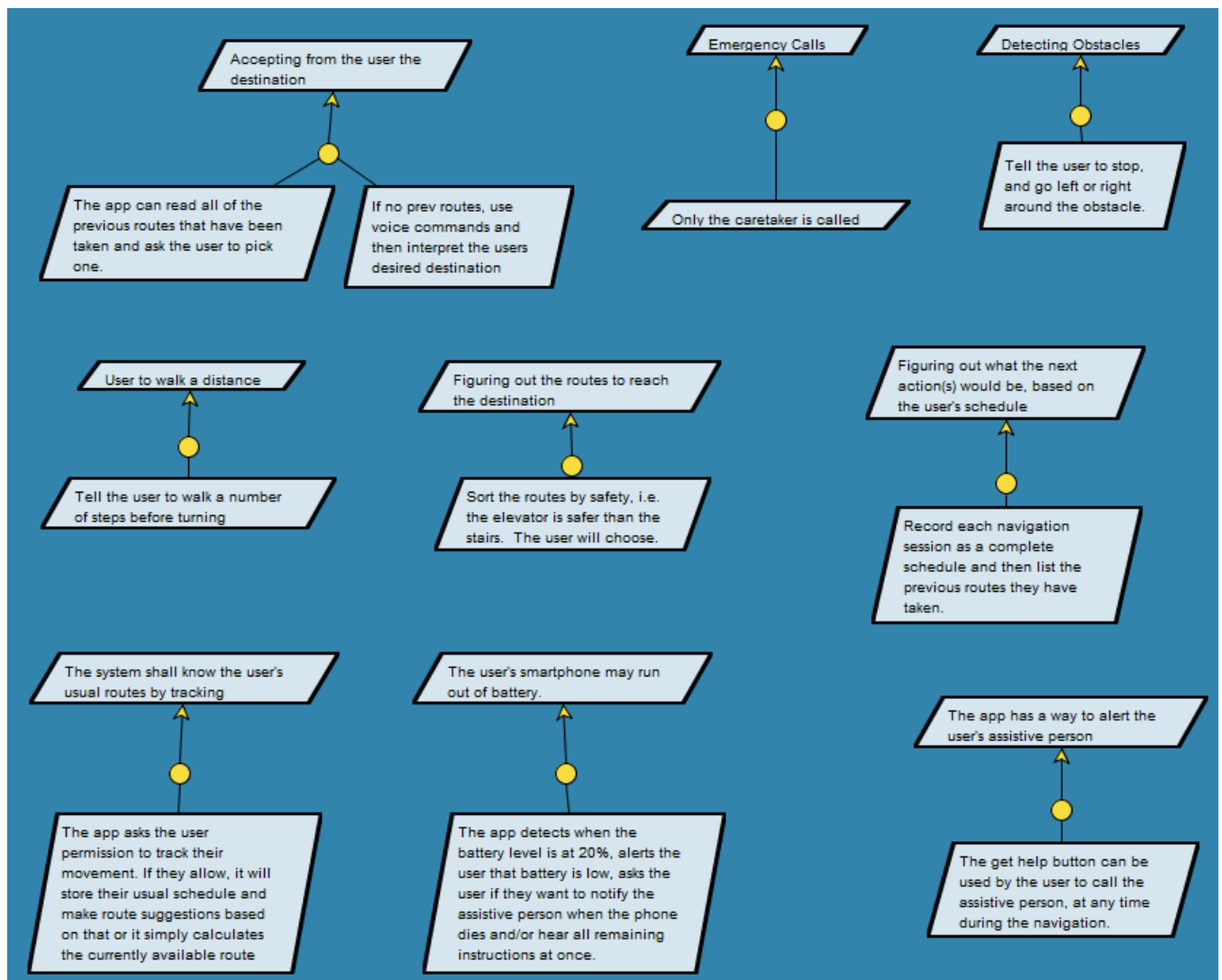


Figure 13. Functional Requirements Issues Solved by Requirements

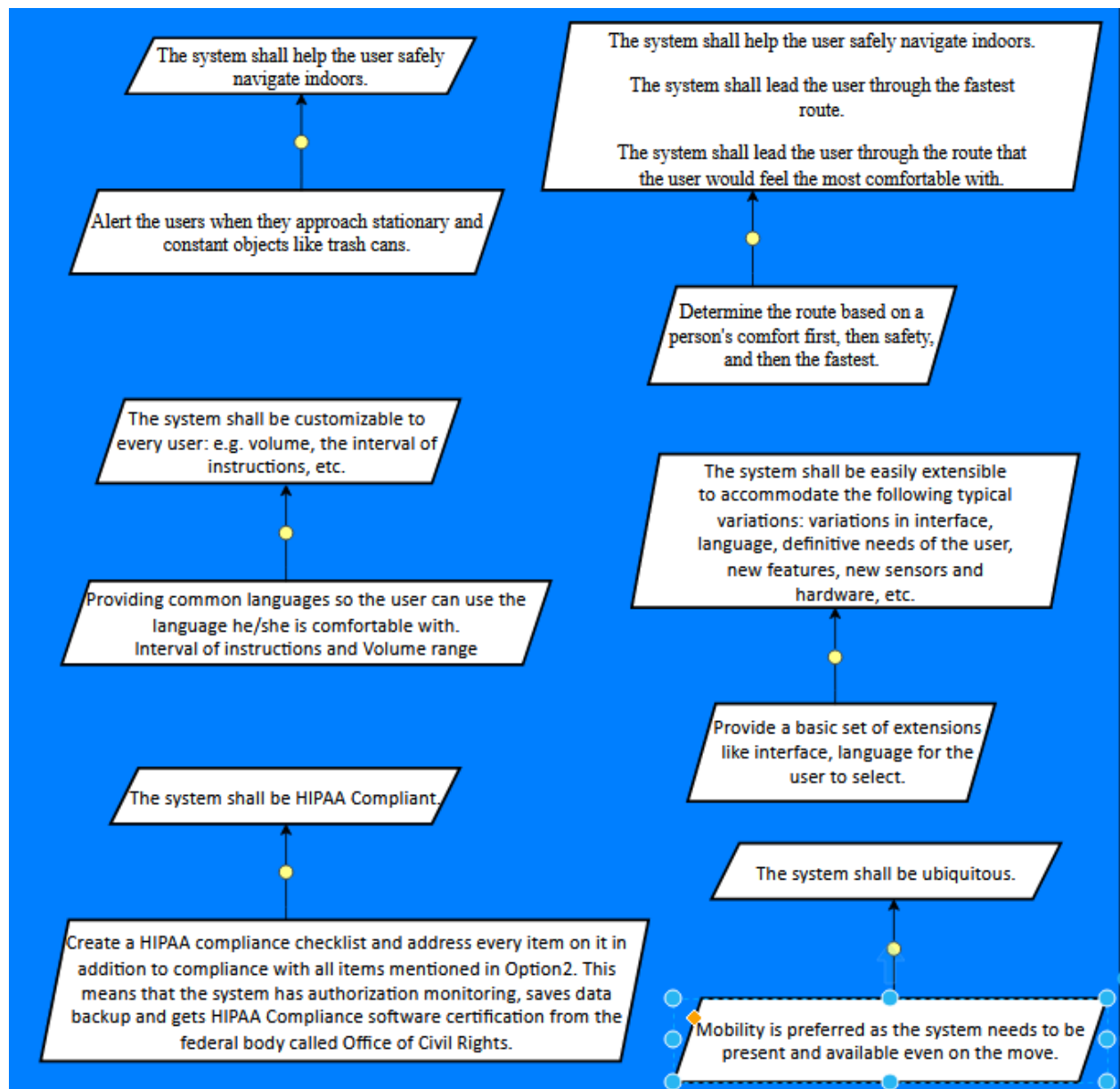


Figure 13. Non-Functional Requirements Issues Solved by Requirements (Used drawio)

4.2.1. Improved Understanding of Functional Requirements

FR ID	Description
FR1	Users can store locations and routes according to actual needs. Specific requirements are as follows:

	<ul style="list-style-type: none"> a. When users view their current location, they can easily save the user's current location with one key. Users can easily bookmark relevant sites when they search for places of interest. b. When planning related routes for users, provide a button using voice recognition to save related routes c. Users are able to check their favorites quickly
Satisfies Functional Requirement Issue	FRI1
Satisfies Objectives	FO2
Satisfied by prototype feature	Routes are stored and can be selected in their favorites.

FR ID	Description
FR2	<p>The application allows users to quickly contact an assistive person in an emergency. Specific requirements are as follows:</p> <ul style="list-style-type: none"> a. Support users to set emergency contacts b. Emergency contacts should support multiple area codes. The default area code is related to the phone system setting region c. There is a one-click button to call emergency contacts on the home page
Satisfies Functional Requirement Issue	FRI2
Satisfies Objectives	FO1, FO2, FO3
Satisfied by prototype feature	The users can click the Help button

FR ID	Description
FR3	<p>The Angle between the user's current orientation and the floor direction is analyzed in real time by collecting data from the magnetic field sensor of the mobile phone. If the Angle between the user's orientation and the floor is greater than the specified threshold, an audio broadcast immediately alerts the user of the Angle between the current orientation and the floor:</p>

	<ul style="list-style-type: none"> a. Different values are set in the alarm threshold "Settings" : 30, 45, 90, 135 and 150 b. The broadcast type of the Angle is left \ right + Angle
Satisfies Functional Requirement Issue	FR13
Satisfies Objectives	FO2
Satisfied by prototype feature	<i>Magnetic Field Sensor</i> is used to measure the magnitude of a <i>magnetic field</i> and use the <i>magnetometer sensor</i> (Compass sensor)

FR ID	Description
FR4	<p>Auriel provides users with route planning functions to destinations.</p> <ul style="list-style-type: none"> a. Calculate the length and estimated time of the route, and through the text screen display and voice broadcast b. The application collect the step size information of users via daily adhibition data and calculate the steps the users need to take within a range of accuracy
Satisfies Functional Requirement Issue	FR15
Satisfies Objectives	FO1, FO2
Satisfied by prototype feature	Inertial and Magnetic <i>sensors</i> measurements are analyzed and fused for detecting <i>steps</i>

FR ID	Description
FR5	<p>Auriel helps users to search for the route to destination:</p> <ul style="list-style-type: none"> a. POI points entered through the Search function can be used as destinations to plan routes. b. Support one-click switch between destination and departure. c. Intelligently plan the best route for walking d. Supports the display of route details, showing the details of the entire navigation. Contains

	<p>each step the user takes in the navigation, including the distance and steering information needed to go straight</p> <p>e. To simulate the situation of walking the whole route before users' formal trip</p>
Satisfies Functional Requirement Issue	FRI5
Satisfies Objectives	FO1, FO2
Satisfied by prototype feature	Support for one-click switch, display of route details, planning best route.

4.2.2. Improved Understanding of Non-Functional Requirements

NFR ID	Nonfunctional Requirement 1	
NFR1	The application will navigate the blind people safely.	
Operationalized Functional Requirements	OFR1	The application will use the obstacle alert system (oas) via the proximity sensor to detect obstacles.
	OFR2	The obstacle alert system (uses proximity sensor) must be performant enough to keep up to walking speed
	OFR3	A buzzer alarm will ring out whenever the connection with phone is lost
	OFR4	A voice prompt will remind blind people if they are walking on the right direction and right way
Satisfies Nonfunctional Requirement Issue	NFR11	
Satisfies Non-functional Objective	NFO1	
Constrains	This system shall use emergency contact system and road deviation warning system to make it implemented.	

Satisfied by prototype feature	The app uses GPS and beacons to alert user of walking down the wrong path.
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NFR ID	Nonfunctional Requirement 2	
NFR2	Auriel provides a default choice for blind people to choose the path using shortest time	
Operationalized Functional Requirements	OFR1	The system shall calculate the shortest path time using the phone calculator. Auriel provides a default choice for blind people to choose the path using shortest time
	OFR2	a. The shortest time path sometimes isn't the same as the shortest path. The conclusion is reached by taking all the circumstances into consideration
	OFR3	b. The system shall use the phone voice recognition function.
Satisfies Nonfunctional Requirement Issue	NFR12	
Satisfies Non-functional Objective	NFO2	
Constrains	This system needs to be combined with a route search system, route collection system and route select system.	
Satisfied by prototype feature	The route is selected based on the fastest path.	

NFR ID	Nonfunctional Requirement 3
NFR3	The navigation system offers a proposal if the user prefers to choose a route with less people and more elevators. If the user needs to use the stairs and elevator, or access the stairs and the elevator, voice should remind the user to pay attention to safety.

Operationalized Functional Requirements	OFR1 OFR2 OFR3	The system shall read the stored data for the app and present the user with options to choose a route. Voice commands are used to communicate safety issues The system offers a proposal if the user prefers to choose a route with less people and more elevators. If the user needs to use the stairs and elevator, or access the stairs and the elevator, voice should remind the user to pay attention to safety.
Satisfies Nonfunctional Requirement Issue	NFR13	
Satisfies Non-functional Objective	NFO1, NFO2, NFO3	
Constrains	This system needs to be combined with a route search system, route collection system and route select system.	
Satisfied by prototype feature	Messages in the app will remind users of safety issues.	

NFR ID	Nonfunctional Requirement 4	
NFR4	Users can adjust the relevant Settings on the application to meet the user's needs	
Operationalized Functional Requirements	OFR1 OFR2	The system shall calculate the broadcast distance. Users can adjust the relevant Settings on the application to meet the user's needs. You can adjust the Settings as follows: a. Speech speed setting: provide users with 10 speed setting options from 0 to 9

	OFR3	b. Volume setting: provide users with ten volume setting options ranging from 0 to 9
	OFR4	c. Broadcast distance setting: set the broadcast distance of POI points such as classrooms, offices, bathrooms, lounges, elevators, etc.
Satisfies Nonfunctional Requirement Issue	NFR14	
Satisfies Non-functional Objective	NFO3, NFO4	
Constrains	This system needs to use proximity sensors, accelerometer, motion sensors to decide the broadcast distance. The voice recognition system is used to verify the modification.	
Satisfied by prototype feature	The configuration page will satisfy this.	

NFR ID	Nonfunctional Requirement 5	
NFR5	The system shall be HIPAA compliant.	
Operationalized Functional Requirements	OFR1	User Authentication: <ul style="list-style-type: none"> The system shall use single-factor authentication. A login and password is set up in the configuration and remembered each time the app is started. The login and password are encrypted. An admin login is used for the caretaker.
	OFR2	Remediation plan: <ul style="list-style-type: none"> Private data (PII) is not written to logs or sent via email.

	<p>OFR3</p> <ul style="list-style-type: none"> • A complete list of all the team members along with their roles, contact, and responsibilities. This can be obtained from the app configuration. • Recovery procedures - The app will need to be reinstalled. No data is stored on servers. <p>Emergency Mode:</p> <ul style="list-style-type: none"> • A complete list of all the team members along with their roles, contact, and responsibilities. This can be obtained from the app configuration. • Recovery procedures - The app will need to be reinstalled. No data is stored on servers. <p>Authorization Monitoring</p> <ul style="list-style-type: none"> • Logs are kept of the transactions. • Once the app is closed, an automatic log off occurs. • The caretaker can login in case of emergency. <p>Data Backup</p> <ul style="list-style-type: none"> • Electronic protected health information (ePHI) is not stored on the app but the information is encrypted and stored in a secure cloud database.
Satisfies Nonfunctional Requirement Issue	NFRI1,NFRI4,NFRI5
Satisfies Non-functional Objective	NFO1

Constrains	If the userId or password is forgotten, the app will need to be reinstalled.
Satisfied by prototype feature	The first page of the app will show a userId and password field.

4.2.3. Specifications

Functional Specification ID	Functional Requirement
FS1	<p>Auriel page layout and start:</p> <ol style="list-style-type: none"> The first page will show a login and password. The next page will contain a text box to show the user the building name using google maps. <ol style="list-style-type: none"> Use the google API to obtain the data. Next all of the rooms are retrieved from the data and are listed and shown as buttons. The user will click a room button to start. The navigation instructions will be shown in text boxes as the user starts to walk. It will then tell the user to take a certain amount of steps, turn right or left, etc. and tell the user to stop once they reach the destination.
Satisfies Functional Requirement	FR1, FR2, FR3, FR4, FR5
Satisfies Objectives	FO1, FO2, FO3
Satisfied by prototype feature	First page is login/pw next page is building name and rooms display via button click. Followed by details on how the user should reach the destination.

Functional Specification ID	Functional Requirement
FS2	<p>Users can store locations and routes and retrieve the data according to actual needs. Specific requirements are as follows:</p> <ol style="list-style-type: none"> Users can use gestures such as 3 finger tap to change the destination.

	<ul style="list-style-type: none"> b. When users view their current location, they can easily save the user's current location with one key. Users can easily bookmark relevant sites when they search for places of interest. c. When planning related routes for users, provide a button using voice recognition to save related routes. d. Users are able to check their favorites quickly e. The navigation system offers a proposal if the user prefers to choose a route with less people and more. f. The system shall read the stored data for the app and present the user with options to choose a route with elevators. If the user needs to use the stairs and elevator, voice commands should remind the user to pay attention to safety.
Satisfies Functional Requirement	FR1, FR2, FR3, FR4, FR5
Satisfies Objectives	FO1, FO2, FO3
Satisfied by prototype feature	A screen is used to store frequently used routes.

Functional Specification ID	Functional Requirement
FS3	<p>Auriel helps users to search for the route to a destination:</p> <ul style="list-style-type: none"> a. POI points entered through the Search function can be used as destinations to plan routes. b. Support one-click switch between destination and departure. c. Intelligently plan the best route for walking d. Supports the display of route details, showing the details of the entire navigation. Contains each step the user takes in the navigation, including the distance and steering information needed to go straight
Satisfies Functional Requirement	FR1, FR2, FR3, FR4, FR5

Satisfies Objectives	FO1, FO2, FO3
Satisfied by prototype feature	The search screen is used

Functional Specification ID	Functional Requirement
FS4	<p>Auriel provides users with route planning and calculation functions to destinations. It calculates the route from the current location to the destination.</p> <ol style="list-style-type: none"> Calculate the length and estimated time of the route, and through the text screen display and voice broadcast The application will collect the step size information of users via daily adhibition data and calculate the steps the users need to take within a range of accuracyRoute calculations: The Angle between the user's current orientation and the floor direction is analyzed in real time by collecting data from the magnetic field sensor of the mobile phone. If the Angle between the user's orientation and the floor is greater than the specified threshold, an audio broadcast immediately alerts the user of the Angle between the current orientation and the floor: Different values are set in the alarm threshold "Settings" : 30, 45, 90, 135 and 150 The broadcast type of the Angle is left \ right + Angle
Satisfies Functional Requirement	FR1, FR3, FR4
Satisfies Objectives	FO1, FO2, FO3
Satisfied by prototype feature	On click of the room button, the most efficient route is calculated

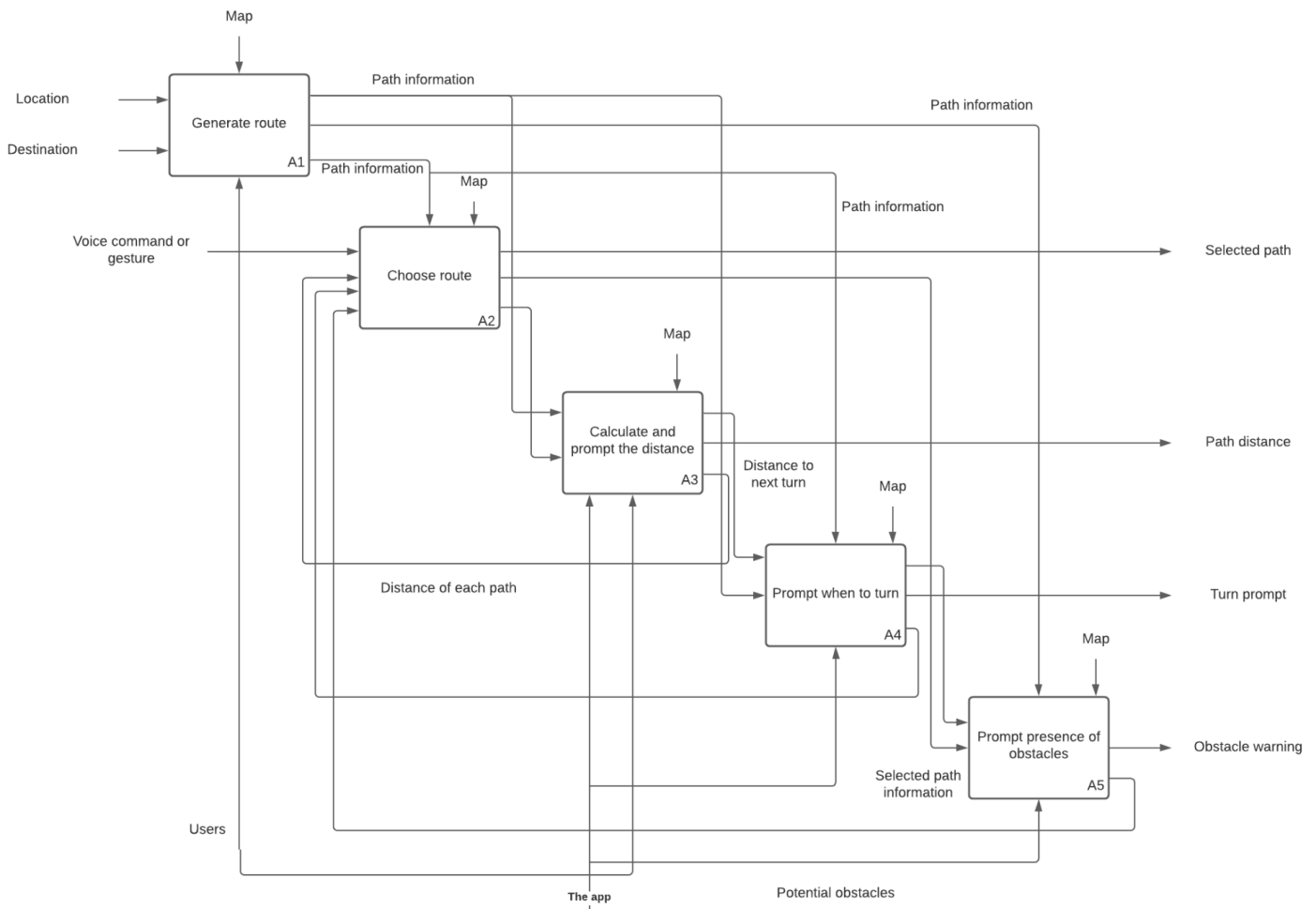
Functional Specification ID	Functional Requirement
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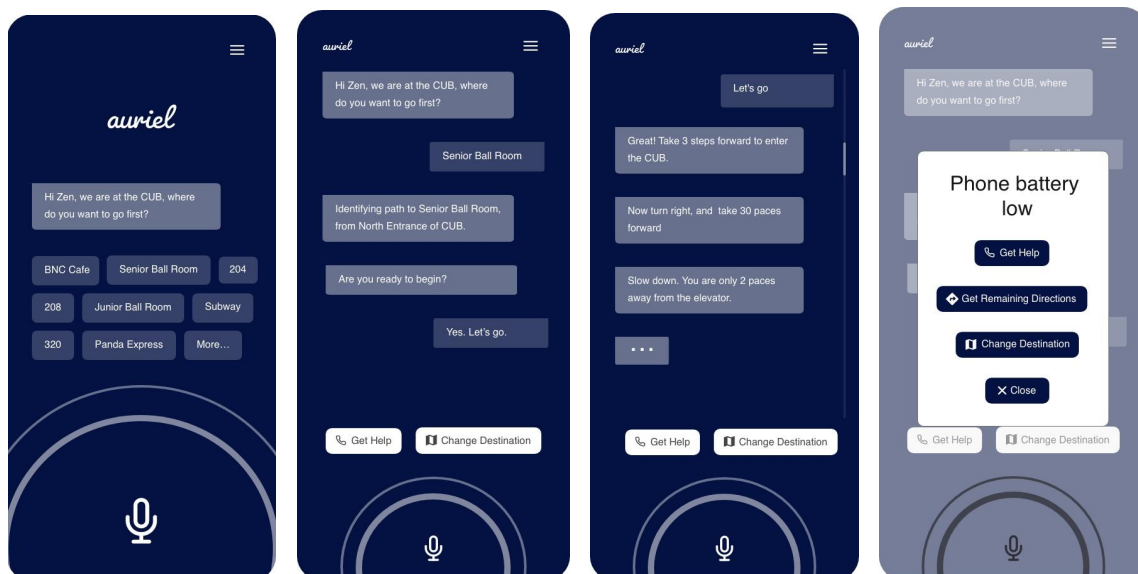
FS5	<p>The application allows users to quickly contact an assistive person in an emergency. Specific requirements are as follows:</p> <ul style="list-style-type: none"> a. Support users to set emergency contacts b. Emergency contacts should support multiple area codes. The default area code is related to the phone system setting region c. There is a one-click button to call emergency contacts on each page. This will call the caretaker or assistant.
Satisfies Functional Requirement	FR2
Satisfies Objectives	FO1, FO2, FO3
Satisfied by prototype feature	A one-click button is used called HELP.

Functional Specification ID	Functional Requirement
FS6	<p>The application notifies a user of a low battery situation.</p> <ul style="list-style-type: none"> a. A popup box will overlay the UI and provide buttons to click: <ul style="list-style-type: none"> i. Get help - calls the caretaker ii. Get remaining directions - continue iii. Change directions iv. Close - close the popup
Satisfies Functional Requirement	FR1, FR2, FR3, FR4, FR5
Satisfies Objectives	FO1, FO2, FO3
Satisfied by prototype feature	A popup box will appear

[5] Prototype Interface Mock-ups

The images below depict a rough mock-up of what the app will look like on the user's phone. The app can accept voice input and also has accessible buttons that the user's screen reader can easily pick up and read.





[6] User Manual

The complete user manual can be found in [this document](#).

6.1. User Instructions for the visually impaired

1. Open the Auriel app.
2. The application would prompt the user for the location they wish to navigate to.
3. The user must specify their destination using the voice command.
4. The application will start navigation with a list of steps prompting the user to navigate.
5. To help navigate the user, the application will start giving out directions (left, right, straight, backward) based on the user's speed and pace. For example, "Take 10 steps to the right".
6. If the application doesn't recognize the location the user says, it might prompt the user to specify the location again.
7. Once the location is reached, the user must open doors to enter, if necessary.

6.2. User Instructions for the Caretaker

1. Open the Auriel app.
2. The application would prompt the user for the location they wish to navigate to.
3. The user must specify their destination using the voice command.
4. The application will start navigation with a list of steps prompting the user to navigate.
5. The user might use the three-tap gesture to ask for help. Once the gesture is done, the app immediately notifies the caretaker of the location of the user.
6. The caretaker can immediately proceed to the user's location and provide help if necessary.
7. In case of a serious emergency, please dial 911.

6.3. Settings

1. Users may adjust the volume to their comfort level.
2. The navigation may be stopped by closing the app.

3. The navigation pauses automatically if the user is stationary.
4. In case of emergency, a button may be pressed to alert the caretaker.
5. In case of low battery, the user may be prompted to continue with the navigation or get assistance.

6.4. Emergency Alert

1. In an unlikely case of an emergency, the GET HELP gesture (three-finger tap) on the screen may be performed to alert the caretaker/assistant to help the user.

All caretakers/assistants are fully aware of the building logistics and will immediately reach the user.

[7] References

[1] Javier Sánchez Sierra (2012): ,Center for Computer Research in Music and Acoustics, Stanford University. *Designing Mobile Apps for Visually Impaired and Blind Users*

[2] S. Vidal, G. Lefebvre, “*Gesture Based Interaction for Visually-Impaired People*”, proceedings NordiCHI 2010, Oct 16-20

[8] Appendix I: Process Details

8.1. Phase 1 Roles:

<u>ROLE</u>	<u>RESPONSIBILITY</u>	<u>TEAM MEMBER</u>
PROJECT MANAGER	Responsible for planning, organizing, and directing the completion of the specific project.	Akshaya Venkatesh
PRODUCT MANAGER	Responsible for identifying the customer need and the larger business objectives that a product or feature will fulfill.	Dr. Bolong Zeng
REQUIREMENTS ENGINEER	Engineer responsible to carefully understand and bring clarity from the given requirements document	David Kelly
SOFTWARE LEAD	Responsible for clarifying and understanding requirements from the development perspective	Pallavi Arivukkarasu
ARCHITECT	Makes high-level design choices	Yinan Guo

	and frame technical standards based on requirement analysis	
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8.2. Meeting

Meeting records have been regularly documented and are available in the following link:

<https://gitlab.eecs.wsu.edu/cpts484-fall21/team-akshaya/-/tree/main/Phase%20I/Team%20Meeting%20Records>

8.2. Activities

Research papers and other applications made for the visually impaired were studied in detail.