CARZ

Charlie Wong, Alec Yeasting, Riley Hunter, Zach Gherman

BlindSight Vision

Version <1.0>

Revision History

Date	Version	Description	Author
11/22/2021	1.0	First version of the Vision Document	Riley Hunter
12/12/2021	2.0	Phase II Version of Vision Document	Riley Hunter, Alec Yeasting, Charlie Wong

Table of Contents

Vision

1. Introduction

1.1 Purpose

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

1.2 Scope

The BlindSight application is a navigation and collision detection system that is being developed by the CARZ development team. BlindSight is a mobile application and system for the visually impaired. Built in will be a fall detection and response system, collision detection system, an audio/vibration-based navigation system, with customizability for the user. The system supports speech to text and vice versa, as well as a vibration feedback system.

1.3 Definitions, Acronyms, and Abbreviations

CARZ – The team developing the BlindSight application. The acronym is based on the first names of the CARZ development team; Charlie Wong, Alec Yeasting, Riley Hunter and Zach Gherman.

1.4 Reference

[1] Erickson, W., Lee, C., & von Schrader, S. (2012). 2010 Disability Status Report: United States. Ithaca, NY: Cornell University Employment and Disability Institute(EDI).

[2] Erickson, W., Lee, C., & von Schrader, S. (2012). 2011 Disability Status Report: United States. Ithaca, NY: Cornell University Employment and Disability Institute(EDI).

[3] L. Chung (2014). *CS/SE 6361 Advanced Requirement Engineering, Spring 2014, Project Phase 1: Requirements Elicitation: Initial Understanding.* [Online]. Available: [material url]

https://www.globenewswire.com/en/news-release/2020/01/30/1977872/0/en/Global-Assistive-Technologies-for-Visually-Impaired-Market-is-Expected-to-Reach-USD-6-57-Billion-by-2025-Fior-Markets.html

2. Positioning

2.1 Business Opportunity

Simulating a navigation/collision detection application. This involves very basic functionality needed. That functionality includes text to speech and speech inputs from the user, a rudimentary navigation system, and a UI mockup.

2.2 Problem Statement

The problem of	Decreased independence
affects	Visually impaired individuals
the impact of which is	Financial, safety, mental health, etc
a successful solution would be	Increased safety and independence for affected

	individuals

2.3 Product Position Statement

For	Visually impaired individuals
Who	Desire greater independence
The BlindSight Application	is a Navigation application
That	Allows visually impaired individuals to have greater independence through speech input navigation and sound based collision detection.
Unlike	Current navigation applications
Our product	Is the bleeding edge of sound/touch based applications

3. Stakeholder and User Descriptions

3.1 Market Demographics

Our users are anticipated to be visually impaired individuals wishing for greater independence in their lives with less financial burden. So far the market value for applications for visually impaired individuals "The assistive technologies for visually impaired market is set to reach US$ 6,493.1 Mn by 2028 from US$ 4,064.4 Mn in 2019 at a compound annual growth rate (CAGR) of 7.8% during the forecast period from 2020 to 2028"[1]. CARZ is new to this sector as the development team is a new startup from the get-go. However, with BlindSight application and services; the development startup is set to break into the new marketplace by storm.

3.2 Stakeholder Summary

Developers	This is a stakeholder that is responsible for system development.	Responsible for overall software/hardware development of the application and fulfilling project requirements.
Google	This is a stakeholder that provides various medium(s) for the system.	Responsible for taking over the world. Also provides maps and location services for the application.
Product Manager	This is a stakeholder that	Responsible for eliciting project requirements to the development team.
Project Manager	This is a stakeholder that is responsible for leading system development.	Responsible for leading the development team's efforts in developing the hardware/software of the system.

[1] https://www.researchandmarkets.com/reports/5264901/assistive-technologies-for-visually-impaired?utm_source=BW&utm_medium=PressRelease&utm_code=m38q3d&utm_campaign=1503766+-+Worldwide+Assistive+Technologies+For+Visually+Impaired+Market+to+2028+-+Mobility+Devices+Will+be+the+Fastest+Growing+Segment&utm_exec=jamu273prd

Hardware Engineer/Lead	This is a stakeholder that is responsible for system hardware development.	Responsible for leading the set up LiDAR, Bluetooth, OS and other hardware components for the system.
Requirements Analysts	This is a stakeholder that elicits requirements of the system.	Responsible for eliciting the requirements for all components of the system, working with the product manager to do so.
Software Engineers	This is a stakeholder that is responsible for system software development.	Responsible for developing the software of the application including UI, software components of the navigation and collision detection.
Test Engineers	This is a stakeholder that is responsible for testing system development.	Responsible for engineering tests for hardware and software system to ensure a robust and working system.
Quality assurance engineer	This is a stakeholder ensure quality of system development.	Responsible for ensuring and assessing quality of the code, software, hardware connections.

3.3 User Summary

Potential Caretaker(s)	Primary end User	Assists with the application use, especially during early releases of the application. Sets up the application and day to day use for the main user. Could be family, friends or caretaking professionals.	-Self
Visual impaired user(s)	Primary end user	Primary user and beneficiary of the application. Uses the application for navigation and collision detection. Might need to secure assistance with the application.	-Self
Customer care and administration	End user	Monitor status of the application and aid where needed to the caretakers and main clients. Mainly this is to be on the technical end such as coverage lapses, errors, faults and failure detection from the primary user end as well as providing customer support and feedback.	-Self

Business owner	End user	Monitor status of the application and aid where needed to the caretakers and main clients. Mainly this is to be on the technical end such as coverage lapses, errors, faults and failure detection from the primary user end as well as providing customer support and feedback.	-Self

3.4 User Environment

User access to BlindSight is mobile, wireless and remote. Early release is set to be on Android smartphones as early as Pixel 2. However the intention is to release BlindSight to Blackberry, iOS, etc in the future conditional on the success of the android version.

3.5 Stakeholder Profiles

3.5.1 Caretaker(s)

Representative	
Description	Private individual who is a family member/friend/employed by the visually impaired individual caretaking them or a member of the medical community hired to care for such individual.
Type	Casual user or caretaking expert.
Responsibilities	Helps set up the system on the user side and helps the end user with day to day end user maintenance of the system.
Success Criteria	Success is proper use of the application and safety of the visually impaired individual.
Involvement	Evaluates the system through day to day use and questionnaires.
Deliverables	
Comments / Issues	

3.5.2 Visually Impaired User

Representative	
Description	Private primary end user that uses the system for greater independence.
Type	Casual User
Responsibilities	Successful, safe, responsible use of the application for needed services.
Success Criteria	Successfully uses the application to safely navigate day-to-day life
Involvement	Evaluates the system through day to day use and questionnaires.
Deliverables	

Comments / Issues	

3.5.3 Customer Care

Representative	
Description	End user that provides support to caretakers and the visually impaired users.
Type	Advanced end user
Responsibilities	Provide support to caretakers in setting up and maintaining day-to-day functionality of the system, maintains the system, and provides direction and response to visually impaired users.
Success Criteria	A well-maintained system, safety and satisfaction of the users.
Involvement	Customer care center to help day-to-day support for application.
Deliverables	User support manuals, 24/7/365 service for the system.
Comments / Issues	

3.6 User Profiles

See previous section.

3.7 Key Stakeholder or User Needs

Need	Priority	Concerns	Current Solution	Proposed Solutions
Broadcast messages	High	Sending the right data to the right stakeholders.	TBD	Send messages to the user and caretaker of location, collision, and fall detection data through speech or test (to remote caregiver).
Usability	High	Visually impaired individuals need to be able to use the application easily, independently and effectively without seeing the screen.	Text to speech and vibrations.	
Responsive	High	Safety is of utmost importance, caretakers and customer support must be able to respond to incidence of users at moments notice.	See broadcast messages.	See broadcast messages.
Security	Moderate High	Prevent hackers from using the system to provide malicious, misleading information to stakeholders.	None	None

3.8 Alternatives and *Competition*

3.8.1 Be My Eyes

Strength: Allows a visually impaired individual to connect to an individual on live stream to be eyes and ears through the phone as the individual is walking.
Weakness: Requires an actual person to be the eyes rather than an automated approach.

3.8.2 Google Maps and Similar

Strength: Accurate location info within meters outdoors, has a speech broadcast service and location tracking.
Weakness: Hard to use for visually impaired individuals and not exact with location indoors, no fall detection, etc. Can provide poor recommendations for visually impaired individuals.

4. Product Overview

4.1 Product Perspective

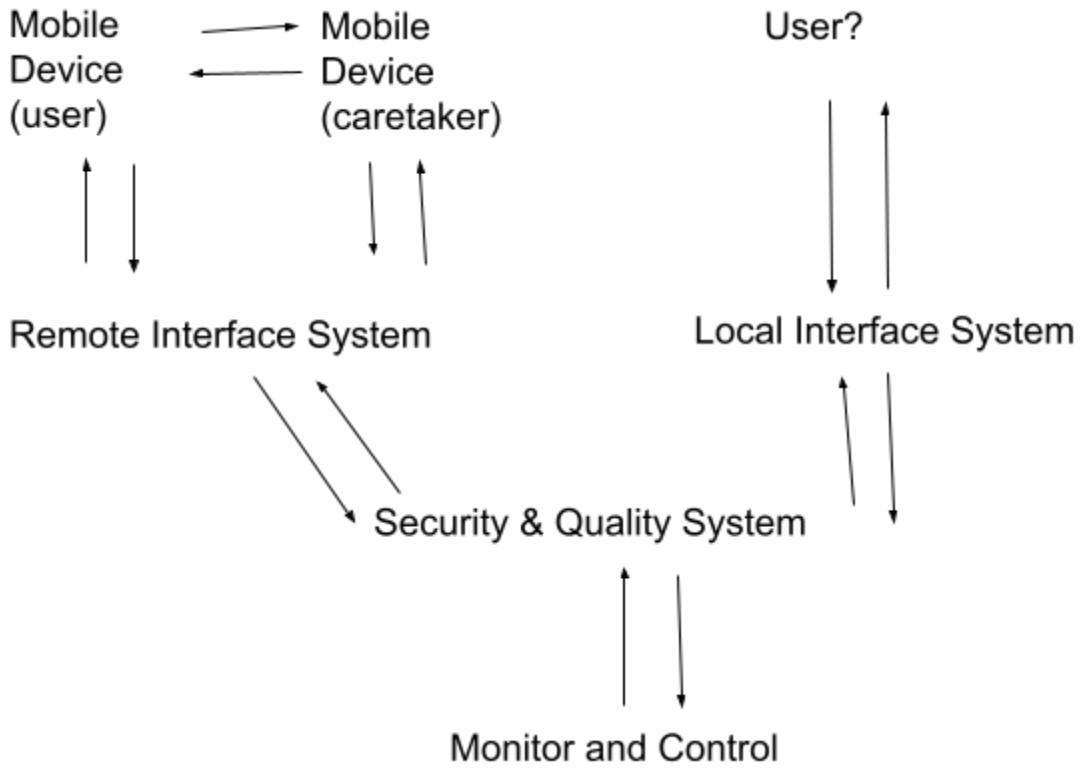


Figure 1 Approximate Blindsight Architecture

4.2 Summary of Capabilities

Table 4-1 BlindSight System

Customer Benefit	Supporting Features
Safely navigate indoors with a minimal amount of outside help	Navigation system Collision detection system Text-to-speech communication
More quickly access emergency services in the case of an extreme event	Fall detection
Recover from confusing navigational moments quickly	Navigation system

4.3 Assumptions and Dependencies

See appendix A for diagrams relating to assumptions and dependencies as BlindSight uses a component based Software Engineering approach.

4.4 Cost and Pricing

Our application will be using the free to try pricing model. After release we are expecting to support the further development of the collision and navigation system. Therefore a subscription model with a low cost of $4.99/month is enough to support ongoing development/research work with a small development team and user base. The free trial period will be one week as that is sufficient for someone to see that our application is as useful as we claim without having to go out of their way to make time to try it before the trial runs out.

4.5 Licensing and Installation

We reserve all rights of control over the code of our application to the extent possible within the Google Play terms of service. The application will be distributed over the Google Play Store to Android users of capable Android versions. Subscription will be done in application rather than through the Play Store itself.

5. Product Scope

5.1 Major Product Features

5.1.1 Text to speech

The application contains text to speech services for navigation information relay. This service takes written instructions produced by the navigation guidance system such as, “turn left in 50 feet” and transforms them into audio output using Android’s built in TextToSpeech controller and playing them at the appropriate time.

5.1.2 Indoor Location Services

The application uses as many built in sensors in Android as possible to determine user position. The sensors used are magnetometer, WiFi, Bluetooth, and the phone’s inertial measurement system (consisting of accelerometer and gyroscope). The output is a relative position coordinate which determines the interactions of the navigation system with the user through text-to-speech.

5.1.3 Navigation Guidance System

The navigation guidance system uses the indoor location services to determine relative user position on a map and the text-to-speech system to communicate to the blind user how they can better match the track of the route. This includes giving feedback to the user when their heading has deviated from the desired route heading to enable the user to get back to facing the desired route heading within some acceptable deviation. This continues until the route's final destination is reached.

5.1.4 Find and Set Route

The application takes blind user input through a seeing eyed surrogate to search from a list of possible destinations to find the desired one. They then select the route using tactile communication and are given the option of starting the navigation guidance system when desired.

5.1.5 Fall Detection

The application runs a subprocess on the indoor location services which scans the position data for anomalies that could indicate the user has fallen. If a fall is detected then it speaks to the user and asks if the user would like to contact emergency services. If the confidence of the system is high enough through natural language processing that the user responds with an affirmative answer then it contacts emergency services providing whatever positioning information it can to dispatchers.

5.1.6 Collision Detection

The application uses the back facing camera along with a distance estimation artificially intelligent algorithm to detect the distances of objects from the user. It also uses the current user position and speed information from the indoor location services to determine relevant objects to the user. It then communicates to the user the objects it has detected as well as avoidance steps for the user to take.

5.2 Initial Release Scope

All features listed in section 5.1 will be included in the initial release as only in combination do they make a minimum viable product. None of the features can be removed without a severe loss of functionality to the final application. Most importantly the navigation and collision detection systems must both be in a usable state otherwise we risk damaging user trust by either making a navigation aid which fails to navigate or a navigation aid which sometimes leads users into potentially dangerous obstacles.

5.3 Subsequent Releases Scope

Given the comprehensive nature of the initial release, future releases will focus on maintenance and

iterative improvement to existing systems. The changes are expected to be quality of life improvements as we receive user feedback on the user experience of our application beyond simply the functionality of it. Future releases will also receive extensive testing on the two key systems, navigation and collision avoidance, before release to ensure that new releases do not damage already adequately working systems.

6. Constraints

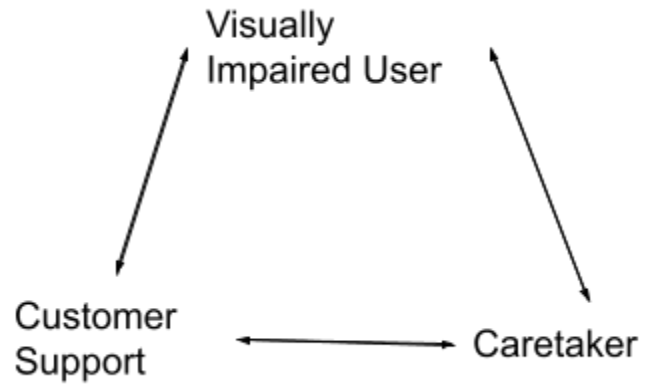
6.1 Security

Fundamental Assumption(s): Systems may be vulnerable to manipulation. Adverse effects to user, caretakers and support team could result.

- Security apparatus is a must to protect communication between stakeholders.
- Privacy is of utmost importance so nefarious actors can't get a hold of user or caretaker locations.
- Identity privacy is also majorly important.
- All device communication, wifi, gps, and bluetooth access must be secure.

6.2 Responsiveness

Fundamental Assumption(s): System must be able to communicate from User end to Caretaker and Customer Support and vice versa for necessary support, help and safety for user..



- Messages pertaining to falls and collisions must be broadcasted to caretakers and customer support.
- Must be in a timely manner.
- Support of requests must be addressed in a timely manner.
- Messages to EMS must be timely, yet accurate.

6.3 Usability

Fundamental Assumption(s): Visually impaired individuals may not be able to fully use a visual based application with the keyboard and small screen size. Visually impaired may also be hearing impaired. Environment may be full of audible distractions.

- Audio Based inputs/outputs for most circumstances are acceptable for most individuals.
- Touch and vibration based systems may be needed for other circumstances.

6.4 Broadcast Messages

Addressed in Section 6.2

7. Precedence and Priority

The importance of each feature is discussed above in section 5 alongside a brief description of the feature and how they relate to initial and future releases of the application.

8. Other Product Requirements

8.1 Applicable Standards

Communication standards:
TCP with up to date SSL certification for subscription login and payment

Legal Standards:
GDPR - General Data Protection Regulation - European Union

Platform Compliance Standards:
Developer Policy Standards - Google Play Store - Google

8.2 System Requirements

Android: Android phone, Android tablet

Version: Android 7.0 or higher

Download locale: Google Play

8.3 Performance Requirements

Factor	Interference Level (1 to 5)	Requirements
Power Use	3.5	Use power sparingly, optimize for battery life for extended use
Quick Startup	2	Start up quickly, monitor memory usage and availability
Responsive	4.5	Respond quickly to user interaction, reinforce responsiveness threshold.

8.4 Environmental Requirements

Factor	Interference Level (1 to 5)	Requirements
Wifi, data and bluetooth available.	5	Optimal for location services, required for communication of necessary information or services. Bluetooth can be of some use.
GPS available.	4	GPS required for location services. Wifi data available can aid in the absence of which.
Ambient noise levels.	2-3	Low ambient noise levels for optimal performance of application functionality such as audible voice inputs,

Radiation levels.	4	Low radiation levels are important for health and safety of user and for wifi performance.
Temperature	2-4	High temperatures can cause the system to overheat. Keep the phone in cooler places for optimal performance.

9. Documentation Requirements

9.1 User Manual

Blindsight Mobile App User's Guide

I. Program Workspace
   - Signing into your account:

     To use the app, you need to sign in using the email address and password of your Blindsight account.

     If you do not have a Blindsight account yet, click **Register** and follow the instructions for 'Registering your account.'
   - App Overview:

     The Blindsight Main page interface consists of four buttons: **Set or search route, Enable/disable collision detection, Edit settings,** and **Exit application.**

- **Set or search route**

  This button provides the user with various options to set a destination and start their navigation.

  Search New Routes: Users can navigate to their desired destination by entering the full address into the search bar. In addition, destinations can be filtered by categories (bathroom, cafeteria, etc.) by clicking the dropdown menu below the search bar.

  Save Routes: Users can save a new route to their history. To save, create a destination from *Search New Route*, then press the **save as** button. A prompt will appear allowing the user to provide a nickname for the saved route and a confirmation message.

  Search Old Routes: Users can access and navigate 'old routes' by entering the destination's nickname into the search bar.

  Start Navigation: Once a route is selected, the user can click the **Start navigation** button; this will direct the user to the map page where navigation & directions will be given by audio.

  Go Back: Users can go back to the main page by pressing the **Back** button.

- **Enable/disable collision detection**

  This button acts as an on/off switch allowing users to enable or disable collision detection at any time (during navigation or on the main page).

  Users can press the **Enable/Disable Collision Detection** button, or use speech recognition to fulfill their needs. Note: this functionality requires collision detection hardware, and is subject to change.

- **Edit settings**

  This button allows the user to edit their settings such as language and privacy. Users can also select and edit questions provided by the questionnaire following the registration setup.

  Alternatively, users can utilize speech recognition and say the following phrase: “Edit Settings” to access and modify their settings.

- **Exit Application**

  This button when selected will return the user to the login page; speech recognition is accessible with the phrase: “exit application.”

9.2 Online Help

No online help is currently planned to be provided for the user directly. All questions will be provided in application. For those struggling they will have to reach out directly to a member of the team whose contact information will be listed in application.

9.3 Installation Guides, Configuration, and Read Me File

I. Blindsight Installation guide

Make sure you own an Android device, go to the Google Play Store, and search for Blindsight.

To find and install Blindsight app for android:

1. On your Android phone, open Google Play
2. Tap the search icon to search for apps & games
3. Enter blindsight in the search field
4. Select Blindsight in the search results and go to the app page
5. Follow the standard installation procedure

II. Read Me File

About the project (Blindsight)

BlindSight is an Android application currently under design and prototyping intended to be used as a navigation aid for blind people. The project aims to utilize a collision detection system for indoor navigation with audio/vibration queues to accommodate the users needs. Specifically, the app will use audio feedback to warn the user of collisions and avert them from the nearby objects. The collaboration service being used for the project is [Google Drive].

Link:
https://drive.google.com/drive/folders/1LYItQNqnYhe0bkE86SYwlCVEKCbbqJdP?usp=sharing

Built With

- Android studio
- Java

Contributors

Android Developers - Alec Yeasting, Charlie Wong, Riley Hunter, Zach Gherman

9.4 Labeling and Packaging

There will be no physical labeling and packaging on this application. All digital labeling and packaging on the application will be done in accordance with Google Play Store requirements for digital distribution.

A Appendix - Component Diagram