Blind Vision

Phase 1

WRS Document

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SE 4351: Requirements Engineering

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Revision History

Date	Version	Changes	Editor
March 7th, 2024	1.0	Starting of the WRS	Tommy
March 7th, 2024	1.0	Preliminary Functional Requirements	Celio
March 7th, 2024	1.0	Preliminary Non-Func. Requirements	Celio
March 11th, 2024	1.1	Functional Requirements	Celio
March 11th, 2024	1.1	Non-Functional Requirements	Celio
March 12th, 2024	1.1	Functional Requirements Issue	Celio
March 15th, 2024	1.2	Introduction Section	Rishi
March 15th, 2024	1.2	Domain Issues Section	Rishi
March 16th, 2024	1.3	Non-Functional Requirements Issue	Celio
March 24th, 2024	1.4	Problem	Ismael
March 24th, 2024	1.4	Goals	Ismael
March 24th, 2024	1.4	Improved Domain	Ismael
March 24th, 2024	1.4	Improved Functional Objectives	Ismael
March 24th, 2024	1.4	Improved Non-Functional Objectives	Ismael
March 24th, 2024	1.4	Specifications	Ismael
March 24th, 2024	1.4	Stakeholders	Celio
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March 26th, 2024	1.4	Revision	Aditya
March 17th, 2024	1.4	Traceability	Aditya
March 22th, 2024	1.0	Prototype	Celio
March 25th, 2024	1.2	Prototype	Celio
March 25th, 2024	1.3	Prototype	Celio
March 26th, 2024	1.0	User Manual	Celio

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Introduction

1.1 Purpose

The goal of this document is to produce a clear, complete, unambiguous, non-contradictory description of what the software requires to do when it is in the hands of blind people. The document will give detail about the issues of the domain, functional requirements, and non-functional requirements as well as many different options to choose from for the solution.

The audience for this document would include the instructor who assigned the project and the TA who will grade the project.

1.2 Scope

The Blind Vision application is focused on enabling blind and visually impaired users to navigate indoors with ease. It utilizes modern smartphone technology to provide real-time guidance, obstacle avoidance, and emergency assistance. The application is compatible with both iOS and Android operating systems, making it accessible to a wide range of users.

1.3 Objectives and Success Criteria

1.3.1 Primary Objectives:

1. To provide accurate and reliable indoor navigation for blind and visually impaired users.
2. To ensure user safety by detecting and alerting users of obstacles and potential hazards.
3. To offer emergency assistance features, such as fall detection and emergency contact notification.

1.3.2 Success Criteria

1. User satisfaction with the accuracy and reliability of navigation.

2. Positive feedback on the ease of use and accessibility of the application.
3. Reduction in navigation-related accidents and incidents among users.

1.4 Definitions, Acronyms, Abbreviations

- Blind Vision: The name of the application being developed.
- GPS: Global Positioning System.
- LIDAR: Light Detection and Ranging.
- NFR: Non-Functional Requirement.
- FR: Functional Requirement.
- UTD: University of Texas Dallas

1.5 Overview

The document is organized into several sections, beginning with this introduction. The following sections include Preliminary Definition, Issues with Preliminary Definition Given, WRS - Word Requirement Specifications, Preliminary Prototype, Prototype Interface Mock-ups, User Manual, Traceability, and References. Each section provides specific details on the requirements, design, and implementation of the Blind Vision application.

Preliminary Definition

2.1 Preliminary Domain

PD_ID	Preliminary Domain Description
PD1	Elderly with vision or memory loss
PD2	Caretakers of said elderly with vision or memory loss
PD3	Police in emergency situations

2.2 Preliminary Functional Requirements

PFR_ID	Description
PFR 1	To create an account the app shall allow users to enter name, height, and an emergency phone number.
PFR 2	The app shall use the smartphone’s microphone, camera, lidar, accelerometer, and GPS can be accessed simultaneously to ensure application functionality.
PFR 3	The main function of the app shall help users to navigate indoors at UTD avoiding obstacles on the ground, and others within the user's height.
PFR 4	The app shall be able to detect if the user falls and ask if he/she needs assistance.
PFR 5	The app shall use the camera or lidar to scan objects in the vicinity, so it must check if the camera or lidar is blocked, if it is, ask the user to stop.
PFR 6	The app shall use the camera to read signs “text” to inform the user about the classroom, bathroom, officers, and others.

2.3 Preliminary Non-Functional Requirements

PNFR_ID	NFR Description
PNFR 1	The app shall be available 24/7 since it runs independently of an operator or internet.
PNFR 2	The app shall be cost-effective to maintain because it does not need operators and a small team can implement it.
PNFR 3	The app shall be reliable to guide blind users safely in an indoor environment.
PNFR 4	The system shall be designed in a scalable way to be implemented in other OS or new features.

Issues with Preliminary Definition Given

3.1 Domain Issues

Domain Issue ID			
DI 1	Description	There are limitations in application accessibility due to the assumption that all users have smartphones.	
	Option A	Mandate the use of Android smartphones	**Pro:** Variety of devices available, strong developer support
			Con: Potentially high costs for users
	Option B	Mandate the use of Apple smartphones	**Pro:** User-friendly interface
			Con: Limited choice of devices
	Option C	No smartphone required	**Pro:**

			Con: The system cannot meet its intended requirements
	Decision	Require Android smartphones, leveraging the benefits in the variety of devices and developer support, which outweigh the cons of higher costs.	

Domain Issue ID			
DI 2	Description	Accurate indoor navigation is challenging without the aid of GPS signals and must address complex obstacles inside the building.	
	Option A	Utilize existing smartphone technologies	**Pro:** No additional hardware required
			Con: May not provide sufficient accuracy for safe navigation
	Option B	Integrate advanced technologies like LIDAR or other indoor positioning technologies	**Pro:** Increased accuracy and reliability
			Con: May involve higher costs and complexity
	Decision	Integrating with advanced technologies like LIDAR was chosen to ensure the highest level of accuracy and safety for users, despite the potential increase in costs and complexity.	

Domain Issue ID		
DI 3	Description	The application's capability to effectively handle emergency situations is under question.

	Option A	Basic emergency features	**Pro:** Easier to implement
			Con: May not cover all potential emergency scenarios
	Option B	Comprehensive emergency features including fall detection and emergency services integration	**Pro:** Enhanced safety for users
			Con: Greater development complexity and potential privacy concerns
	Decision	Comprehensive emergency features were chosen to ensure the highest level of safety features, prioritizing user security over developmental simplicity.	

Domain Issue ID			
DI 4	Description	User privacy and data security are paramount, given the application's access to sensitive information.	
	Option A	Basic encryption and security measures	**Pro:** Easier to implement
			Con: May not comply with all privacy regulations
	Option B	Advanced end to end encryption and regular security protocol updates	**Pro:** Robust protection of user data
			Con: Could require more resources to maintain
	Decision	Option B is adopted to ensure the utmost security and trust in the application, aligning with privacy regulations and user expectations.	

3.2 Functional Requirements Issues

FR Issue ID	Description	
FRI 1	PFR 1	To create an account the app shall allow users to enter name, height, and an emergency phone number.
	1- How to decide between picture or sound for PFR 1.	
	Option 1	Play sound when the app opens and play sound to read the inputs. To enter the values the user speaks and the system enters the values on the input.
	Option 2	Play sounds only that ask for the input values to the user.
	Option 3	Let the user start using the app and create an account late.
	Choice	Option 1
	Rationale	There is a single button at the beginning to create a new account. Blind users can listen to what is being displayed, be able to enter the inputs by speaking, and listen to the feedback to check the value.
Satisfied by	FR1	

FR Issue ID	Description	
FRI 2	PFR 2	The app shall use the smartphone's microphone, camera, lidar, accelerometer, and GPS can be accessed simultaneously to ensure application functionality.
	1- How to decide between picture or sound for PFR 2.	
	Option 1	Ask permission to use GPS, camera, lidar, and microphone.
	Option 2	Allow users to configure GPS, camera, lidar, and microphone

		permissions late on settings.
	Choice	Option 1
	Rationale	The first time the app is opened it will display a pop-up with text and also play sounds asking permission to use GPS, camera, lidar, and microphone.
Satisfied by	FR2	

FR Issue ID	Description	
FRI 3	PFR 3	The main function of the app shall help users to navigate indoors at UTD avoiding obstacles on the ground, and others within the user height.
	1- How to decide between picture or sound for PFR 3.	
	Option 1	Display a text saying that the user can hit something or directions to avoid.
	Option 2	Play sounds to warn users to avoid an object ahead or between his/her height.
	Choice	Option 2
	Rationale	While the user walks inside a building, the app will scan the surroundings and user height and play a sound to warn the user.
Satisfied by	FR3	

FR Issue ID	Description

FRI 4	PFR 4	The app shall be able to detect if something happens to the user and ask if he/she needs assistance.
	1- How to decide between picture or sound for PFR 4.	
	Option 1	Show a button so the user can select for assistance, or want to message to the emergency number.
	Option 2	Play sound asking if the user needs assistance or wants to message to the emergency number.
	Option 3	Play sound asking if the user needs assistance and also message to the emergency number.
	Choice	Option 3
	Rationale	If the user has an accident the sound should ask if the user needs assistance and if the user answers ‘Yes’ message the emergency contact and send the user location also call to UTD 991.
Satisfied by	FR4	

FR Issue ID	**Description**	
FRI 5	PFR 5	The app shall use the camera or lidar to scan objects in the vicinity, so it must check if the camera or lidar is blocked, if it is, ask the user to stop.
	1- How to decide between picture or sound for PFR 5.	
	Option 1	Display a pop-up to warn the user that the camera or lidar is blocked.
	Option 2	Play sound when to warn the user that the camera or lidar is blocked, and ask the user to stop moving.
	Choice	Option 2

	Rationale	While the app is in usage it must check frequently if the camera or lidar has been blocked. If they are, immediately ask the user to stop and unblock the camera.
Satisfied by	FR5	

FR Issue ID	Description	
FRI 6	PFR 6	The app shall use the camera to read signs “text” to inform the user about the classroom, bathroom, officers, and others.
	1- How to decide between picture or sound for PFR 6.	
	Option 1	Display the text into the screen so the user can read.
	Option 2	Read the signs “text” in the classroom, bathroom, or wet floor signs to the user.
	Choice	Option 2
	Rationale	While the user walks the app will read the text in signs to inform the user.
Satisfied by	FR6	

3.3 Non-Functional Requirements Issues

NFR Issue ID	Description	
NFRI 1	PNFR 1	The app shall be available 24/7 since it runs independently of an operator or internet.
	1- What is availability?	
	Option 1	Functional

	Option 2	Accessible
	Option 3	Strong
	Choice	Option 2
	Rationale	The app is available and can be used any time 24/7 even if the user does not have access to the internet.
Satisfied by	NFR1	

NFR Issue ID	Description	
NFRI 2	PNFR 2	The app shall be cost-effective to maintain because it does not need operators and a small team can implement it.
	1- What is maintainability?	
	Option 1	Feasible
	Option 2	Operational
	Choice	Option 1
	Rationale	The owner will have no need for a large investment, or a large team to develop or maintain the app, since the main function is to walk blind safely.
Satisfied by	NFR 2	

NFR Issue ID	Description	
NFRI 3	PNFR 3	The app shall be reliable to guide blind users safely in an indoor environment.

	1- PNFR 3.	
	Option 1	Safe
	Option 2	Dependable
	Choice	Option 1, Option 2
	Rationale	
Satisfied by	NFR 3	

NFR Issue ID	Description	
NFRI 4	PNFR 4	The system shall be designed in a scalable way to be implemented in other OS or new features.
	1- What is scalability?	
	Option 1	Encrypted
	Option 2	Expandable
	Choice	Option 2
	Rationale	The app must be designed for further expansion in the future to other OS or new features.
Satisfied by	NFR 4	

WRS - Word Requirement Specifications

4.1 W

4.1.1 Problem

Problem ID	Problem Description	Corresponding Goal
P1	How can a blind person avoid obstacles through an environment using this app?	G1:Improve obstacles safety
P2	How can a blind person identify objects around them using the app?	G2: Increase surroundings awareness
P3	How can a blind person stay safe in an emergency using this app?	G3: Enhance emergency help

4.1.2 Goals

Goal ID	Goal Description	Backward Traceability	Forward Traceability
G1	Improve obstacle safety	Challenges of navigating obstacles	Implement obstacles audio alerts. Develop voice navigation.
G2	Increase surroundings awareness	Importance of knowing surroundings	Provide sound description for object recognition. Enable Location sharing. Send danger alerts.
G3	Enhance emergency help	Emergency needs for the blind	Facilitate one-tap help call. Establish an emergency service link. Offer an emergency audio guide for instructions.

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

4.1.3.1 Improved Domain

Improved Domain ID	Improved Domain Description
ID 1	Challenges faced by blind people in moving around obstacles in unfamiliar environments.
ID 2	Assistive technologies and functionalities that can support safe and independent travel for blind people.

4.1.3.2 Stakeholders

Of: Lawrence Chung, Accessibility Office, and UTD Police.

By: Celio ‘Requirement Engineer’, Tommy ‘Architect Engineer’, and Aditya, ‘Tester Engineer.’

For: Blind students, Accessibility Officers, UTD emergency and police, or users that assist the blind users.

4.1.3.3 Improved Functional Objectives

Improved FR Objective ID	Objective Description	Alleviates Problems	Achieves Goals
IFRO 1	The app shall give audio directions.	Prevents dumping into things.	Helps blind people walk safely.
IFRO 2	The app shall use vibrations for warnings.	Warns of nearby hazards.	Makes walking safer.

4.1.3.4 Improved Non-Functional Objectives

Improved NFR	Objective Description	Alleviates Problems	Achieves Goals

Objective ID			
INFRO 1	The app shall quickly warn about obstacles.	Helps avoid bumping into things	Makes walking around safer and easier
INFRO 2	The app shall save battery power.	Prevents the app from draining the phone's battery quickly.	Allows longer use without recharging.

4.2 RS

4.2.1 Functional Requirements

FR_ID	Description
FR 1	The app shall allow users to enter data to create an account to use the app.
FR 2	The app shall access and use microphone, camera, lidar, accelerometer, and GPS.
FR 3	The app shall guide users to navigate UTD indoor buildings safely.
FR 4	The app shall detect if the user falls and needs assistance and send a message and location to his/her emergency contact.
FR 5	The app shall detect if the smartphone camera and other sensors are covered and ask the user to stop.
FR 6	The app shall be able to read signs “text” to the user.

4.2.2 Non-Functional Requirements

NFR_ID	NFR Description
NFR 1	The app shall be available and running 24/7.

NFR 2	The app shall be cost effective.
NFR 3	The app shall navigate the users safely indoors.
NFR 4	The app shall be scalable to be implemented in other OS or new features.

4.2.3 Specifications

Functional Specification ID	Functional Requirement
FR 1	The app shall alert users about the obstacles with sounds.
FR 2	The app shall describe surroundings to users with voice.

Preliminary Prototype

Prototype Interface Mock-ups

User Manual

This is the user manual v.1 and all instructions were made based on the functionalities designed in the previous versions of the prototype.

7.1 Functionalities

7.1.1 Functionalities

Description here….

7.1.2 Functionalities

Description here….

7.1.3 Functionalities

Description here….

7.1.4 Functionalities

Description here….

Traceability

8.1 Forward/Backwards Traceability

Functional Requirement	Designs(Functions)
FR1: Create an account	Create Account
FR2: Hardware Access	Allow Access
FR3: Navigate Users Safely	Navigation
FR4: Fall Detection	Fall Detection
FR5: Camera Detection	Camera Blocked
FR6: Signs “text”	Text Speech

References

WRS Template: *https://personal.utdallas.edu/~chung/SE4351/WRS-template.pdf*, Prof. Chung. Accessed 03/09/2024.

Non-Functional Requirements: https://personal.utdallas.edu/~chung/SYSM6309/NFR-18.pdf, Prof. Chung. Accessed 03/19/2024.