Comet-Vision

SE6361.001 SPRING 2022

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Problem Statement

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

As-Is & To-Be Scenario I

AS-IS

Adam is a visually-impaired student and wants to attend his Requirements Class and doesn't have any clue where to take turns. This results in Adam missing his turn and getting lost in ECSS.

As-Is & To-Be Scenario I

TO-BE

Adam lets the app "Comet Vision" know that he wants to attend his RE class with the help of voice recognition. The app will navigate him by letting him know how many steps he to take and in which direction to get to his class safely and on time.

As-Is & To-Be Scenario II

AS-IS

Suddenly, Adam comes across an obstacle while heading to his destination but is not aware of it. This results in Adam running into the trashcan and getting injured by falling or tripping.

As-Is & To-Be Scenario II

TO-BE

Comet-Vision will immediately detect the obstacle and notify Adam with a voice feature and a sound alert so that he doesn't fall and get himself injured.

Questionnaire

QUESTIONNAIRE

This is a short questionnaire that will help the development team of *Comet-Vision* determine how helpful the application will be for visually impaired students, faculty, and staff to navigate indoors of ECSS at The University of Texas at Dallas. This will be used to understand any problems or struggles that are currently being faced and to help brainstorm ways to improve and solve those issues.

Background Information

Age Range: □ 15 – 21 □ 21 – 30 □ 31 – 40 □ 41 – 50 □ 51 – 60 □ 61 or above
Role at UTD: □ Student □ Faculty □ Staff □ Visitor
Phone #: _____
Email: _____

1. How often do you use your cellular device?

   ○ Never   ○ Monthly   ○ Weekly   ○ Daily

2. Are you comfortable with using a cellular device?

   □ Yes   □ No

   If not, please explain:
   _____
   _____
   _____

3. What do you use your cellular device the most for?

   □ Internet   □ Social Media   □ Music   □ Camera
   □ Map   □ Calls/Text Messages   □ Games
   □ Other: _____

4. How often do you come to campus?

   ○ Never   ○ Monthly   ○ Weekly   ○ Daily

5. What are the reasons you come to campus (select all that apply)?

   □ Attending Class   □ Studying   □ Meeting Instructors
   □ Social Events   □ Meeting Friends   □ Other: _____

6. Do you currently have any concerns when walking indoors from one place to another?

   □ Yes   □ No

   If yes, please explain:
   _____
   _____
   _____

7. Do you currently use any tools to help navigate indoor spaces?

   □ Yes   □ No

   If yes, which tools do you use?
   _____
   _____

   If yes, what are some things you like or that are helpful about the tool you use?
   _____
   _____

   And what are some things you dislike or that are difficult about the tool you use?
   _____
   _____

8. What are some challenging obstacles you run into when walking indoors?
   _____

9. Are there any obstacles that you had a hard time detecting with your tool?
   _____
   _____

10. What is the most challenging part when navigating indoors for you?
    _____
    _____
    _____

11. What do you currently do if you need assistance (ex. get lost, run into someone, etc,.)?
    _____
    _____
    _____

12. Have you ever asked anyone for help when navigating to your destination?

    □ Yes   □ No

    If yes, were their directions ever confusing or hard to understand?

    □ Yes   □ No

    If yes, please explain/describe further about the situation:
    _____
    _____
    _____

13. Do you always take the same route when going from one place to another?

    □ Yes   □ No

14. What factors do you consider when choosing a route?
    _____
    _____
    _____

15. Would you be comfortable with taking a different route that is unfamiliar to you?

    □ Yes   □ No

16. What is a feature that could be helpful for you to navigate around indoors?
    _____
    _____
    _____

17. What emergency systems do you currently use in case of falls or accidents?
    _____
    _____

18. Suppose you have fallen or are in trouble. Who would you want your phone to first contact? Please rank them in order.

    ____ Contact Person (family, friends, etc)
    ____ UTD Office of Student AccessAbility
    ____ 9-1-1
    ____ University Police
    ____ Other (please specify): _____

19. What form of measurement would you prefer for quantifying distances?

    □ Meters   □ Feet   □ Steps   □ Other: _____

20. What are some kinds of icons or menu items you would like to have access to when first opening the application?
    _____
    _____
    _____

21. Would you be comfortable with using headphones to use this application?

    □ Yes   □ No

Please let us know any comments, requests, or questions:
_____
_____
_____

7. Do you currently use any tools to help navigate indoor spaces?

□ Yes   □ No

If yes, which tools do you use?

_____

_____

If yes, what are some things you like or that are helpful about the tool you use?

_____

_____

And what are some things you dislike or that are difficult about the tool you use?

_____

_____

12. Have you ever asked anyone for help when navigating to your destination?

□ Yes   □ No

If yes, were their directions ever confusing or hard to understand?

□ Yes   □ No

If yes, please explain/describe further about the situation:

_____

_____

_____

Questionnaire Sample Questions

Stakeholders

FOR	BY	OF
Visually impaired	Development Team of Comet Vision	Comet-Vision Team of UTD
• Students	• Requirements Engineers: Vishakha, Jun & Jeongwon	
• Staff	• Test Engineers: Jyothise & Miao	
• Faculty	• Software Engineers: Pragya & Abishek	
• Visitors		
Assistants (trusted individuals)		
Police (9-1-1 & UTD Campus Police)		
UTD Office of Student Accessability		

Functional Requirements

FR_ID	Description
FR_01	The system shall locate the current location of the user
FR_02	The system shall display an interactive interface for both the user and their assistant (friends, family, etc,.)
FR_03	The system shall allow the user to customize the notification sounds
FR_04	The system shall allow the user to add their preferences regarding their emergency contacts
FR_05	The system shall give concise directions to the users
FR_06	The system shall detect obstacles and warn the users to avoid collision
FR_07	The system shall tell the users when to stop at the right place for a turn or change in direction
FR_08	The system shall contact the user's emergency contact or other services based on their preference via call or text message when detecting a fall or an accident
FR_09	The system shall alert and notify the user when they start navigation and when they have arrived at their destination

Functional Requirements continued

FR_ID	Description
FR_10	The system shall find multiple routes to the user's destination and choose the best route based on their preferences
FR_11	The system shall be able to identify the destination based on the room number
FR_12	The system shall keep track of shortcuts or favorite routes taken by the user
FR_13	The system shall push notifications according to the user's course schedule or personal schedule registered into the system

Non-Functional Requirements

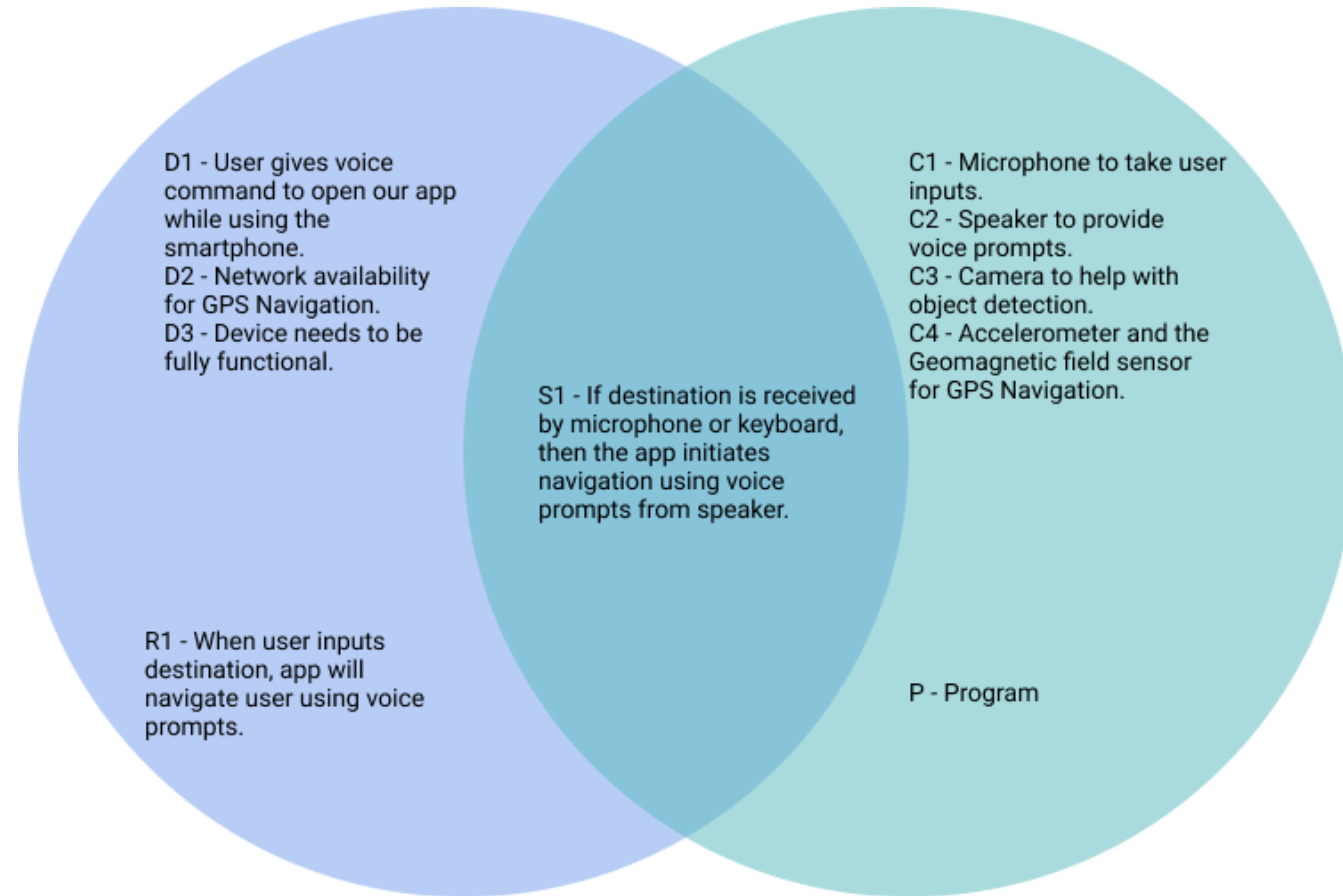| NFR_ID	Description
NFR_01	The system shall help the user safely navigate indoors
NFR_02	The system shall be user-friendly
NFR_03	The system shall be reliable
NFR_04	The system shall be maintainable
NFR_05	The system shall be portable
NFR_06	The system shall be adaptable
NFR_07	The system shall be ubiquitous
NFR_08	The system shall be responsive
NFR_09	The system shall be customizable to every user based on their preferences
NFR_10	The system shall be extensible to accommodate different variations in interface, language, new features, new sensors and hardware, etc,.

Functional Specifications

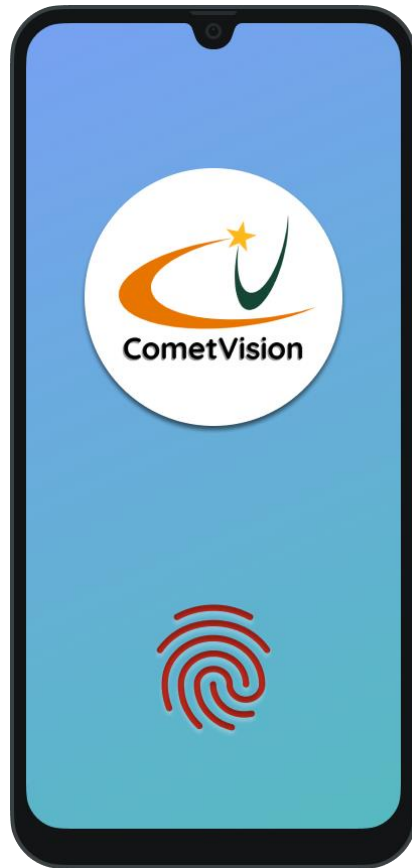| FS_ID	Description
FS_01	The system shall be able to accept voice input (speech-to-text) from the user utilizing the device's built-in microphone or from their headphones/earphones
FS_02	The system shall be able to accept text input from the built-in keyboard on the device
FS_03	The system shall utilize GPS location (geomagnetic sensor and accelerometer) and the CAD map to identify both the user's current location and their desired destination
FS_04	The system shall utilize vibration motor to produce vibrations when notifying the user when they start and end navigation
FS_05	The system shall utilize the built-in accelerometer and gyroscope sensors to track the user's movements and detect when the user is falling
FS_06	The system shall utilize the built-in proximity sensor to measure the distance between the user and the detected obstacle(s)
FS_07	The system shall utilize the alarm system of the device to send alarm notifications to the users based on their schedule and preferences

Traceability Matrix of FR <--> NFR

	NFR_01	NFR_02	NFR_03	NFR_04	NFR_05	NFR_06	NFR_07	NFR_08	NFR_09	NFR_10
FR_01	✕	✕								
FR_02		✕								
FR_03				✕					✕	
FR_04				✕				✕	✕	
FR_05	✕	✕						✕		
FR_06	✕					✕	✕			✕
FR_07		✕	✕					✕		
FR_08		✕						✕		
FR_09					✕			✕		
FR_10		✕	✕			✕				
FR_11		✕				✕				
FR_12				✕			✕			
FR_13		✕						✕		✕

WRSPM Model

D1 - User gives voice command to open our app while using the smartphone.
D2 - Network availability for GPS Navigation.
D3 - Device needs to be fully functional.

C1 - Microphone to take user inputs.
C2 - Speaker to provide voice prompts.
C3 - Camera to help with object detection.
C4 - Accelerometer and the Geomagnetic field sensor for GPS Navigation.

S1 - If destination is received by microphone or keyboard, then the app initiates navigation using voice prompts from speaker.

R1 - When user inputs destination, app will navigate user using voice prompts.

P - Program

Prototype I

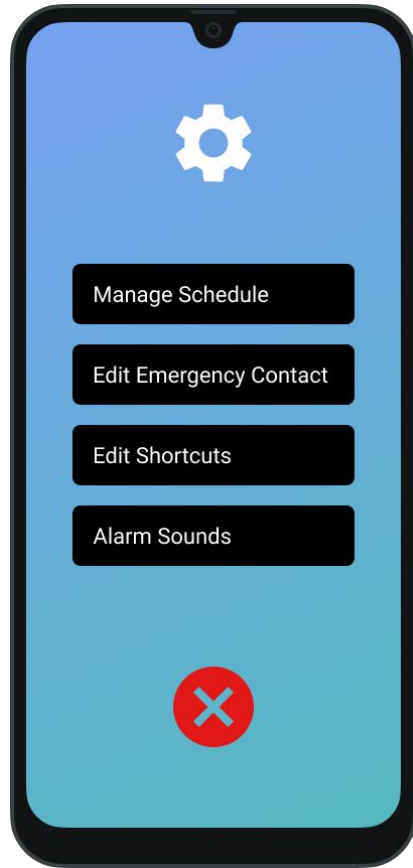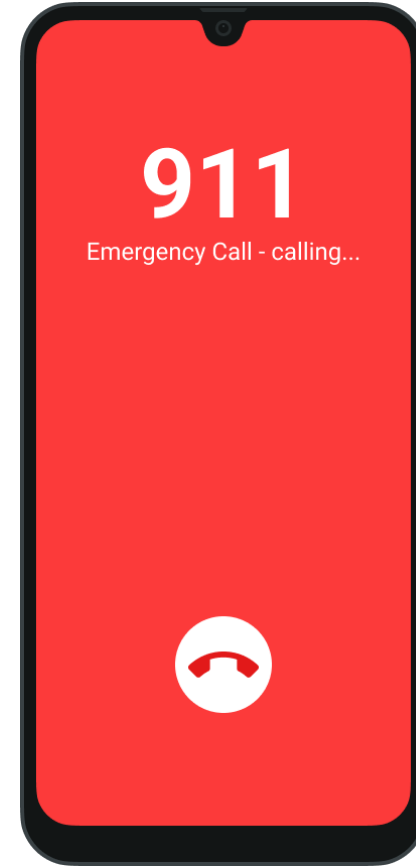Login Page   Main Page   Start of Navigation   End of Navigation
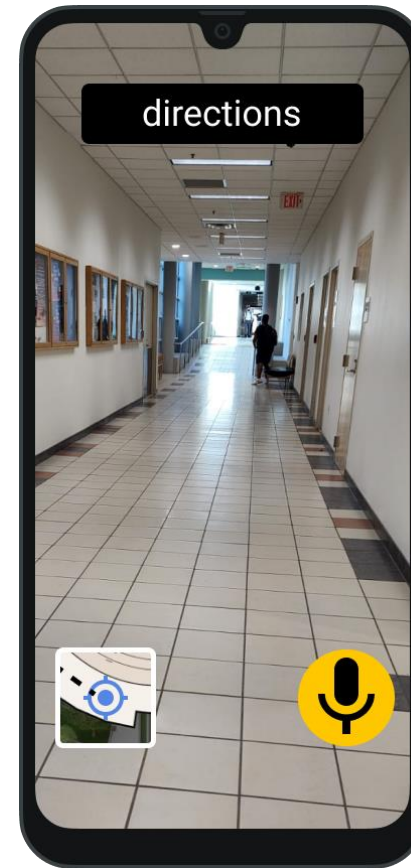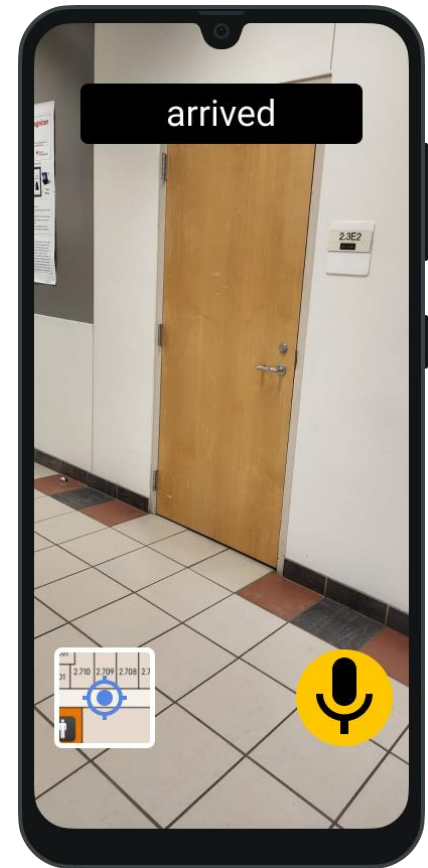
Prototype II

Settings Page

User Emergency Page

Requirements Creeping Rate

We estimate our requirements creeping rate to be low (< 20%). The following factors contribute:

- We started early in the semester and conducted the weekly meetings to make incremental process.

- We had good and effective discussions between team members. And each member gave feedbacks actively.

- We designed the questionnaires based on potential real-world scenarios to better understand the functional and non-functional objectives.

- Issues and clarifications were identified early, and were corrected, modified accordingly.

- Team has experience with mobile application development. We have chosen features which will be feasible to be implemented.

Why is Comet-Vision the Best?

➢ Our team has a solid understanding of software requirement analysis. We designed and improved the requirements with the help of questionnaires and various requirement models.

➢ We have designed every aspect of our application to be both useful and user-friendly to the blind people.

➢ We have kept a clear traceability between problems and goals, functional requirements and non-functional requirements, functional specifications and non-functional specifications to make sure each problem raised is provided with a solution and all requirements are well managed and implemented.

➢ Our team has extensive software engineering and mobile application development knowledge.