Software Requirements Specification

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Guide Blind

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Section 1. Assumptions, Limitations, Constraints

1.1 Assumptions

- All the equipment in the environment of the smart building are functioning. Accidental changes, construction, and other physical changes are concurrently are updated in the system.
- The system is robust and fault tolerant.
- System is active and is facilitated with proper power backup, network connectivity and redundancy servers to ensure the real time functional system.
- The user understands all the instructions and performs the actions appropriately.

1.2 Limitations and Constraints

- The accuracy of user's location depends upon the signal strength and effectiveness of the access points.
- The sensors in the cane are sensitive and their reception is limited, thus the accuracy of the obstacle detection is a serious limitation.
- The system will not function in absence of power, and network failures. It will just send distress message using the auxiliary.
- In case of emergencies, authorized personal should be responsible for safety of the user.

**detailed assumptions and limitations are stated in the respective modules.*

Section 2. System Overview

2.1 Top Level Diagram

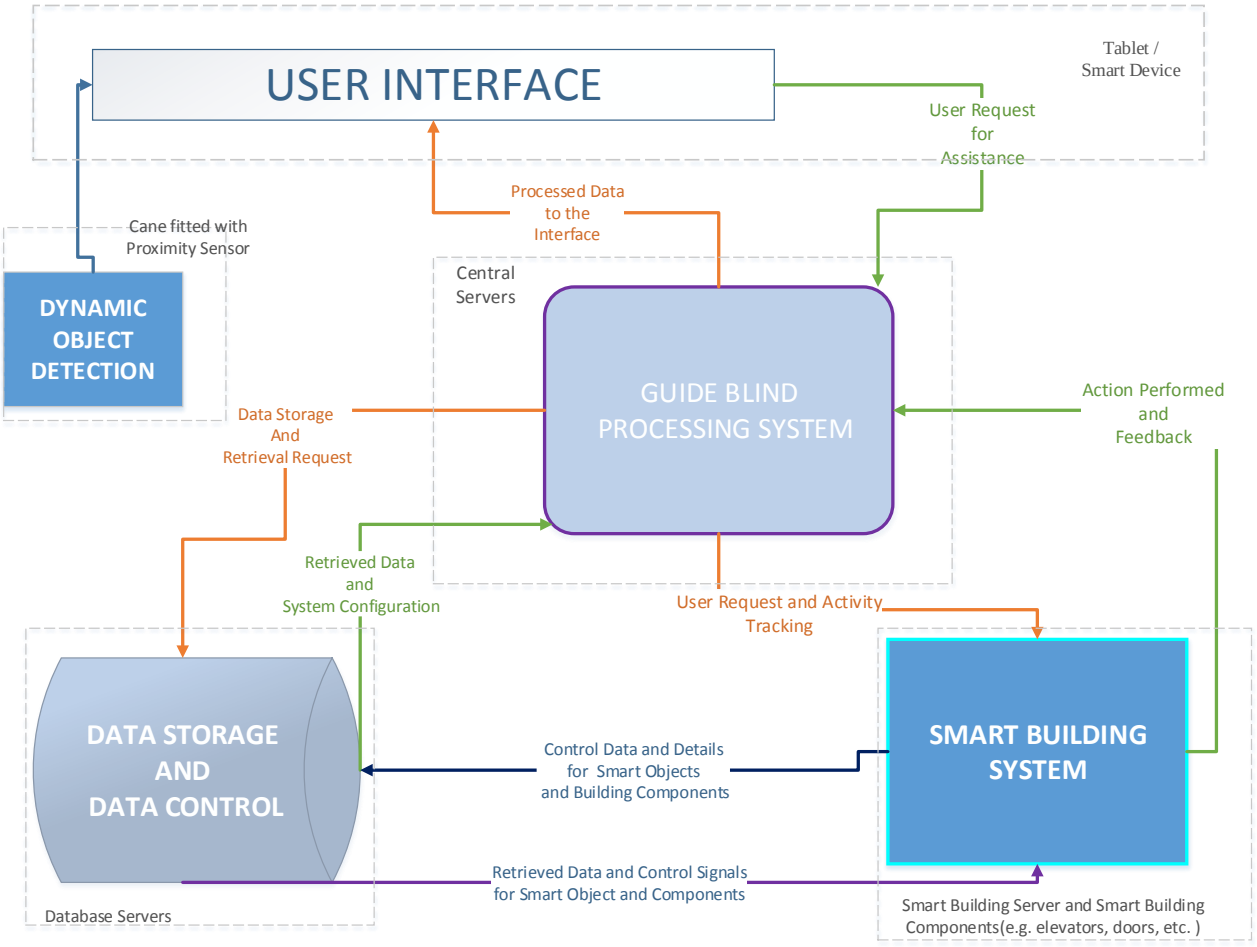


Figure 1: Top Level Diagram

2.2 Description

- Application is developed for various mobile operating systems such as Android, IOS and Windows Mobile. The system is initiated by user after entering the building through voice authentication. The application initializes the user's configuration and the system performs its various functionalities. The main objective of the system is to provide a hassle free path for the user from the user's current location to the desired destination.
- The user has to provide the desired destination to the application via a voice input, which triggers the user triangulation and path detection modules to provide the path from current position of the user to the destination. The system uses the user's current location in the

building to build the most effective and optimal path to the destination based on the maps stored in the servers. The step by step instructions as a voice output will be sent to the user's phone. The system architecture has been designed to provide a robust and fault tolerant application. Various modules are hosted on the specific servers that perform their functionality independently. These servers are monitored and controlled by a master group of servers hosting the control module. This architecture provides a loosely coupled, fault tolerant and control redundant system. Furthermore, there are various other components in the system such as reminders, dynamic object detection and smart building components which in all encompasses the main idea of providing blind users an environment of more independence and freedom. Thus enabling them with an ability to navigate an unfamiliar building in a self-reliant manner using the application and the smart cane.

2.3 Software Architecture Diagram

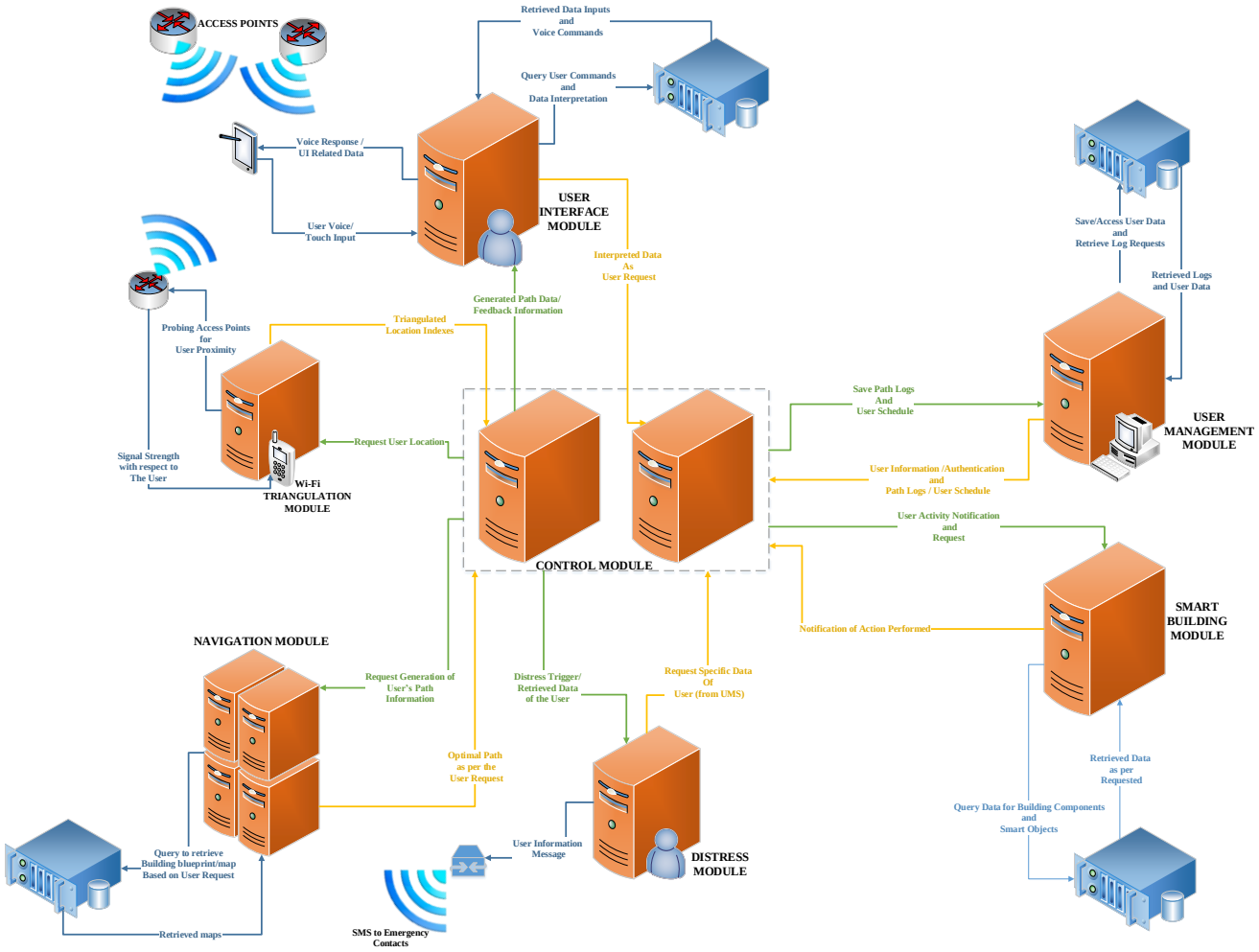


Figure 2: Software Architecture/Block Diagram

Section 3. Major Software Modules

The section describes the principle software components.

3.1 Navigation Module

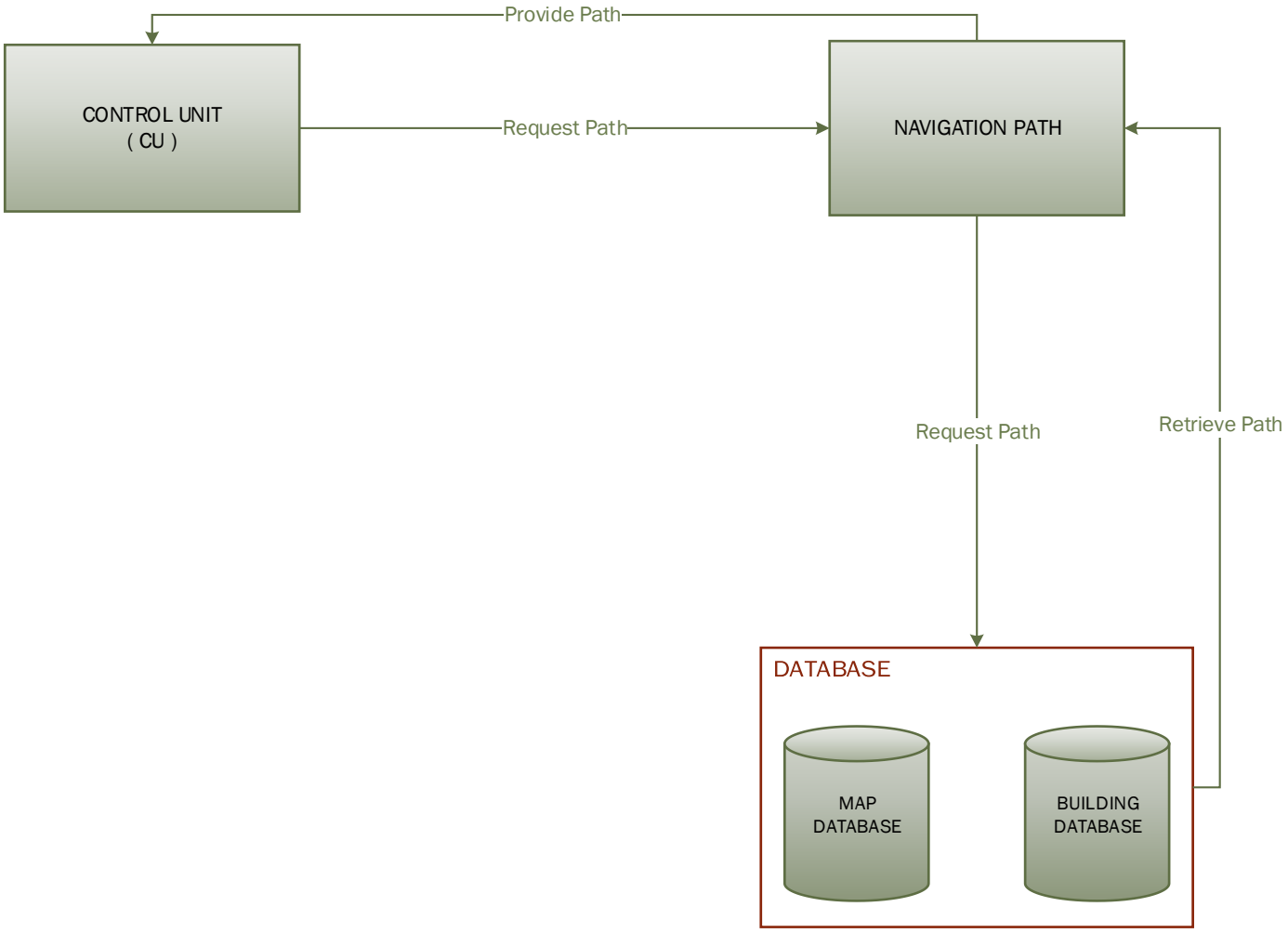


Figure 3: Navigation Module

The purpose of this module is to generate the best obstacle free path for user navigation.

Assumption:

1. The map obtained from the database is accurate.
2. The databases are functional and are connected to the network.

Input:

1. The Control Module requests the Navigation Module to generate a path by facilitating the user's current location.
2. The database provides the accurate map for processing the request of control unit.

Output:

1. The Navigation Module sends the corresponding path to the Control Unit.
2. The Navigation Module sends request for the map of the requested building to the Map Database.

Functionalities Performed:

1. The module performs the function of generating the path, which further is used to help the user reach his desired destination.
2. In addition to the path, a detailed description of the path to be followed is presented to the user.

Limitations:

1. The accuracy of the path, depends upon the accuracy of the map and the user's coordination with the provided instructions.
2. The module is dependent on the Triangulation Module and thus the functioning of Triangulation module should be accurate to determine the appropriate path.
3. Navigation Module then returns the requested path to the Control Unit.

3.2 Wi-Fi Triangulation

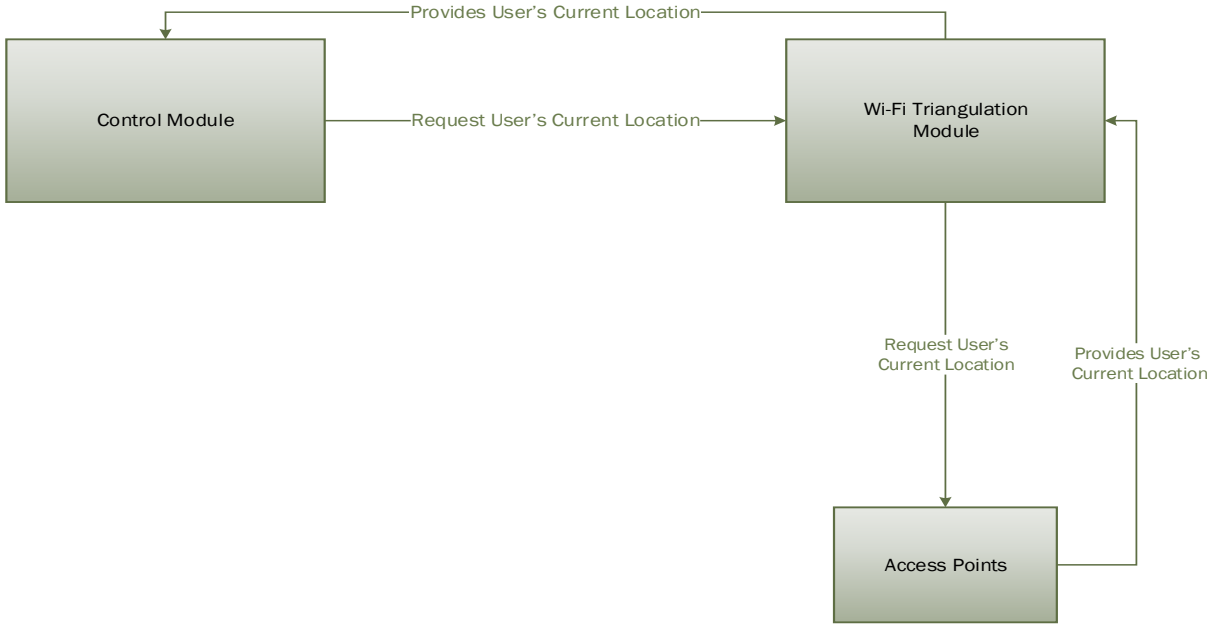


Figure 4: Wi-Fi Triangulation

This module is used to find the current position of the user. This technique used for positioning with wireless access points is based on measuring the intensity of the received signal.

Assumptions:

1. The building is equipped with functional network hardware such as wireless network and access points.

Input:

1. Input is sent by the Control Unit to Request User's Current Location.
2. WIFI-Triangulation Module retrieves the signal strength corresponding to the requested device information from the Access Points in the network.

Output:

1. The signal strength is received from the access points by the WIFI Triangulation Module.
2. The User Location is calculated and sent to the Control Module.

Functional Requirements:

1. The module is used to obtain the location of the user.

Limitations:

1. The accuracy of the triangulation depends upon the signal strength received.
2. In places where the network strength is weak, it becomes difficult to obtain the accurate locations.

3.3 Smart Building Module

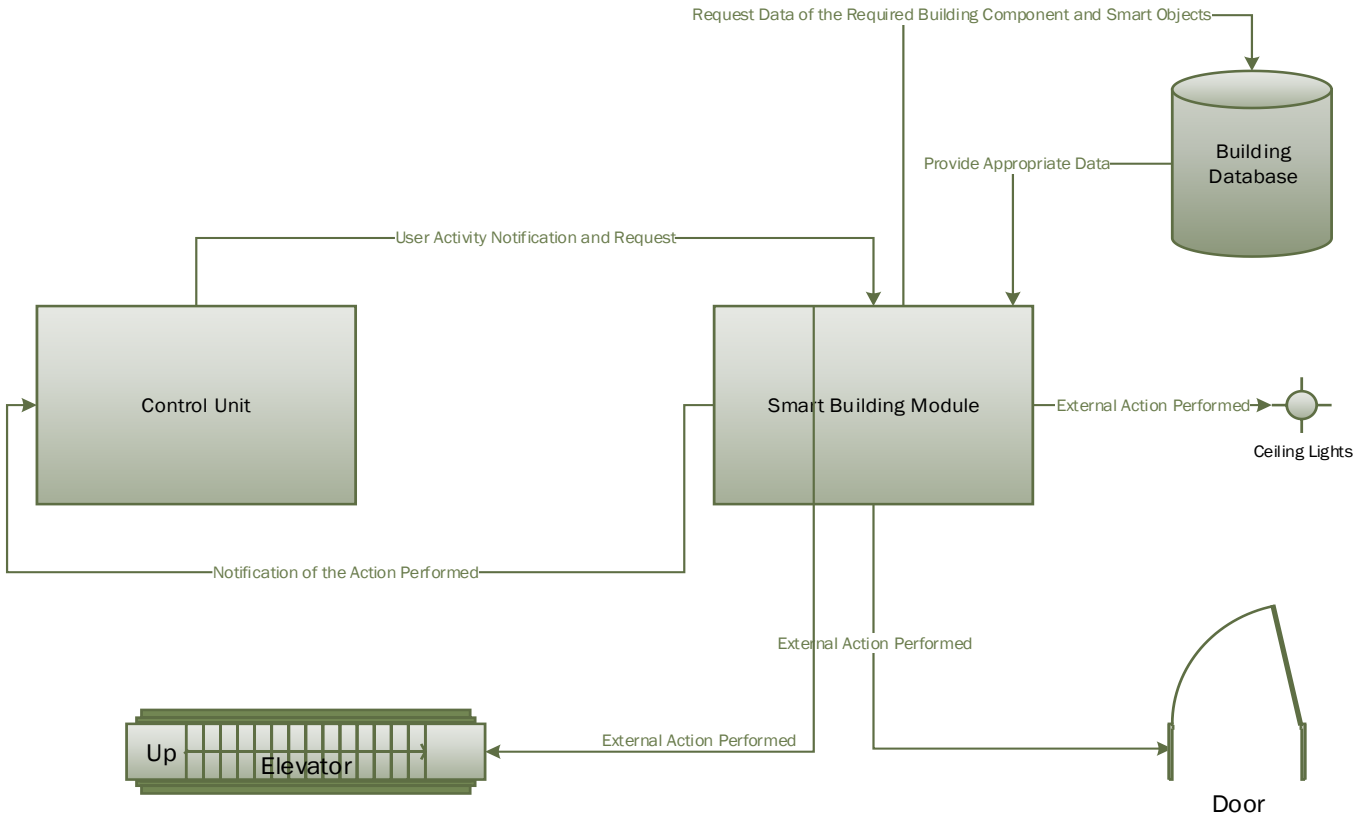


Figure 5: Smart Building Module

The purpose of this module is to control the building components, specifically the doors, elevators and smart objects for user's navigation. The module controls the specific building locations, wherever the user is present for instance near a door, the module opens the door for the user.

Assumptions:

1. The building has integrated its functionality in a way that all the components of building including doors, lighting systems and elevators have been connected to implement the module.
2. The network and connections are available all the time.

Input:

1. The Control Module sends provides the current location of the user along with the user's path and destination.
2. The Smart Building Module incorporates the information and identifies the specific components which need to perform the action.

Output:

1. The Smart Building Module performs the desired action with the identified component.

2. The Smart Building Module sends the corresponding notification to the user about the action performed.
3. The Control Module further processes the feedback from the Smart Building Module and deploys it to User Interface Module where the feedback is converted into voice and the user receives the action.

Functionalities Performed:

1. The function of Smart Building has been implemented using this module.

Limitations:

1. The Smart Building Module requires proper functioning equipment to perform the desired function. Thus the module depends upon the functioning of the building components.
2. The scenario of failures for the system would be in case of breakdown of any building component such as elevator breakdown, failure of electric power supply and repairing of the electrical components.
3. The system has tried to integrate the external environment in the system and thus different domain experts need to contribute for proper functioning of the building components.

3.4 Control Unit Module

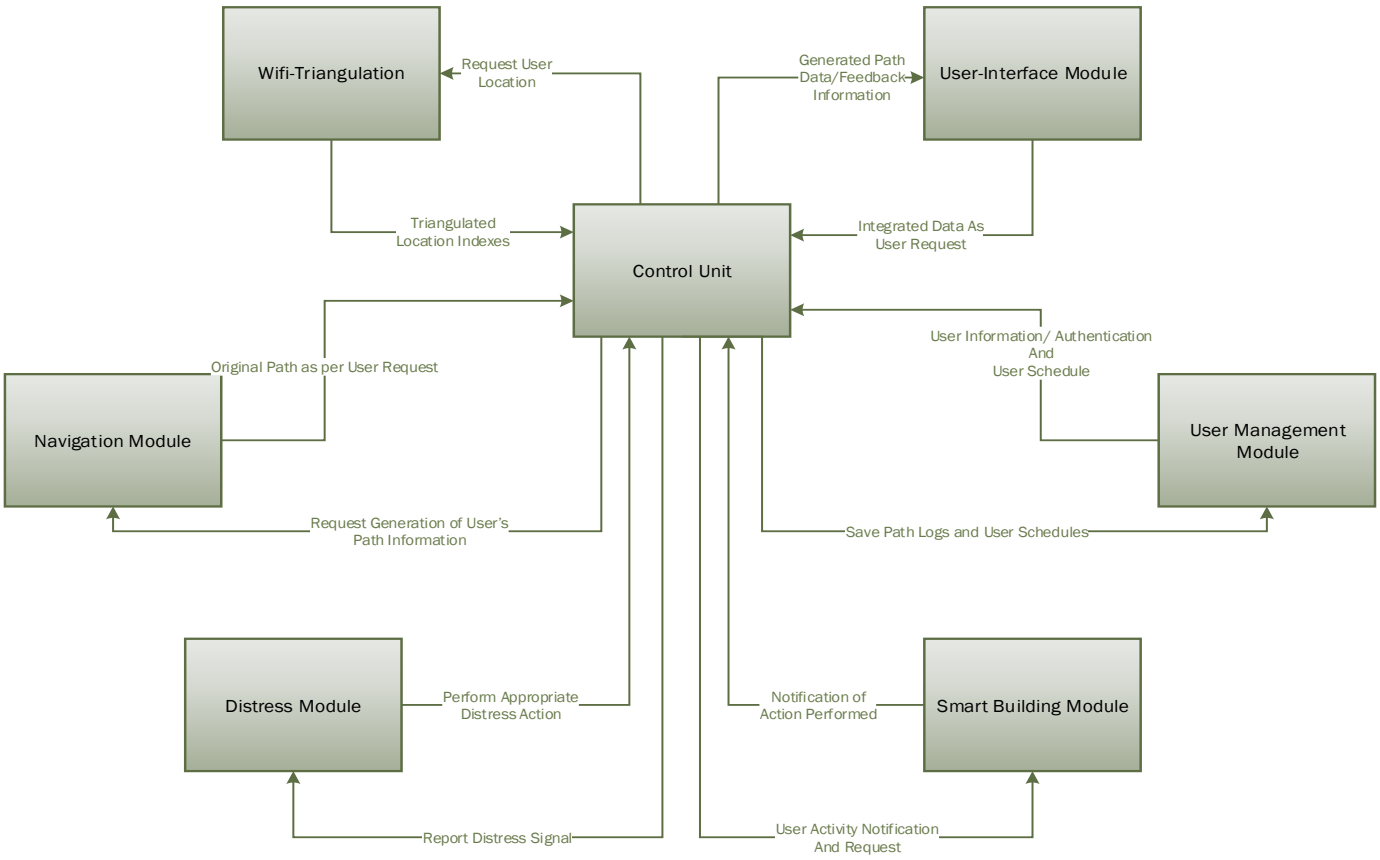


Figure 6: Control Unit Module

The Control Module is the central system, which coordinates the message generated from the different modules and identifies the appropriate modules to process the desired commands.

Assumption:

1. All the modules have been incorporated and perform their desired functions.
2. The system has been perfectly initialized and the network is available 24 x 7.

Input:

1. For different modules different inputs have been set up and communication is performed. The Control Module receives information from the following modules -
    a. User Interface Module (Request Destination/Emergency/Update Information)
    b. Navigation Module (Generated Path)
    c. WIFI Triangulation Module (Triangulated Location Index)
    d. Smart Building Module (Feedback of the action performed)
    e. Distress Module (Feedback of the distress/fail safe function performed)

f. User Management Module (User Information/ Authentication / Schedule)

Output:

1. The following outputs are sent to the corresponding modules -
    a. User Interface Module (Generated Path/ Data Feedback)
    b. Navigation Module (Request Generation of User's Path Information)
    c. WIFI Triangulation Module (Request User Location)
    d. Smart Building Module (User Activity Notification and Request)
    e. Distress Module (Report Distress Signal)
    f. User Management Module (Save Path Logs and User Schedules)

Functionalities Performed:

1. The Control Module is the Central deploying system which performs the appropriate action and sends it to the appropriate module to perform its functionality.
2. It has an important role to serve and thus must be functional 24 x 7.

Limitations:

1. The Control Module needs a backup in case of failure to continue the system functionalities.
2. The Control Module can serve as a bottleneck and thus must be implemented carefully to obtain speed and efficiency.

3.5 Distress Signal Module

There will be three ways of triggering the distress signal. 1 Automatic and 2 Manual

In the automatic method, if the connection between the server and user interface is disrupted and several attempts to re-establish the connection to the user interface by the server has failed, then the server sends a distress signal to the concerned authorities (These may be the registered family members of the user or the staff in Davis Hall)

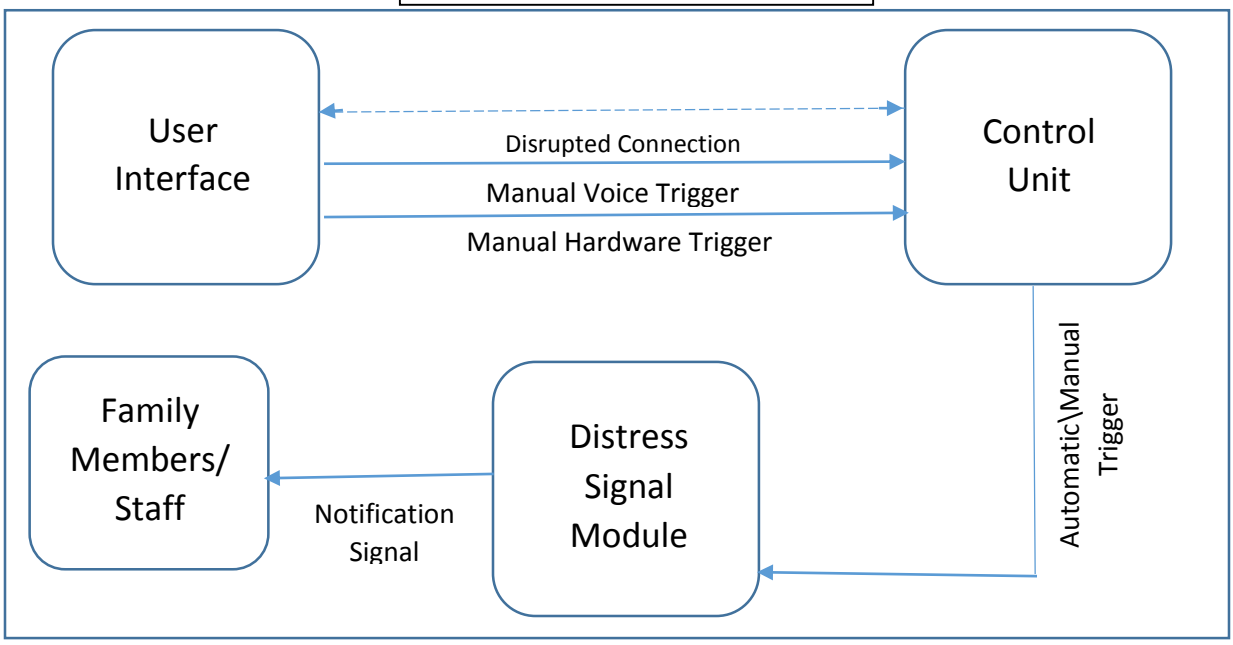
For e.g. - The server will send the last know location of the specific user to the corresponding authorities.

The manual method to trigger the distress signal can be done in two ways as per the user's convenience.

In the first manual method the user will be pressing a special button on the hardware of the user interface. This button is specifically designed on the top left side of the hardware panel and the user is aware of this button when the hardware is in his/her hand. Whenever the user is stuck or is in danger, he/she can hold this button for 4 seconds, which will trigger the distress signal and the family members or staff can be notified.

If the user is not able to find the hardware button or the hardware is out of his reach and wants to use the distress signal, then another manual method of triggering the distress signal is by voice. The user interface will be in an 'Always Listening Mode', where in the microphone will be always ready for voice commands from the user. Now if the user gives a special voice command such as 'Help Me', the user interface will ask the user for a confirmation for sending a distress signal and the user will respond with a 'Yes' and thus the distress signal will be triggered.

Figure 7: Distress Signal Module



3.6 Feedback System Module

The main feature of the Feedback System Module will be to accept the feedback generated by the user interface application. The application will generate data from time to time regarding a specific user to build a profile for the user. This data will be of the form of a schedule, wherein the day to day activities of the user will be recorded and sent as feedback to the User Management Module of the main server to build a user management profile.

Also another sub feature of this module will be that it will record any form of feedback from the user. The user can record a voice message and leave the feedback by going in the feedback menu by saying 'Feedback Menu'. If the user has any doubts or questions regarding any of the features of 'Guide Blind', he/she can easily let us know through the feedback system. This data generated by the user feedback will be fed to the User Management Module as raw data.

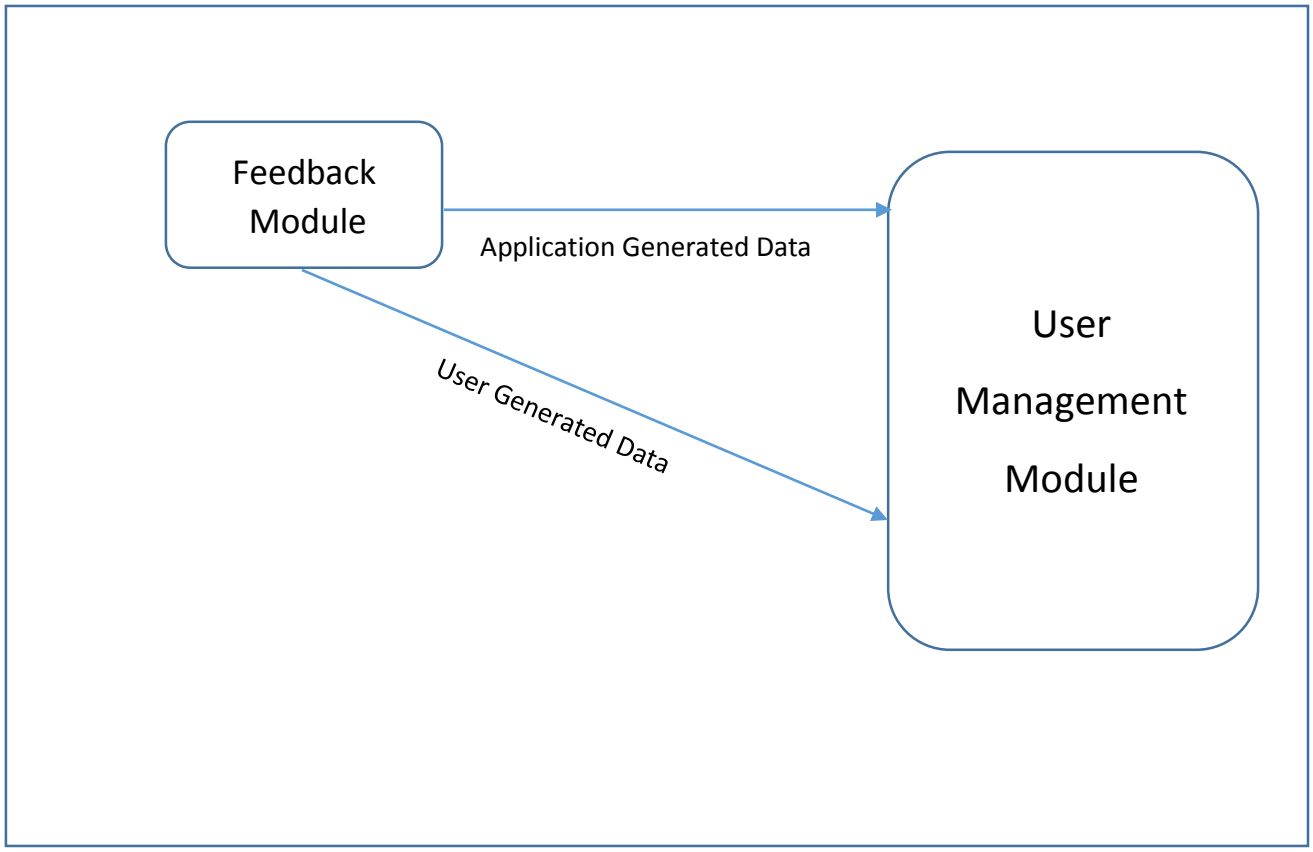


Figure 8: Feedback Module

3.7 User Management Module

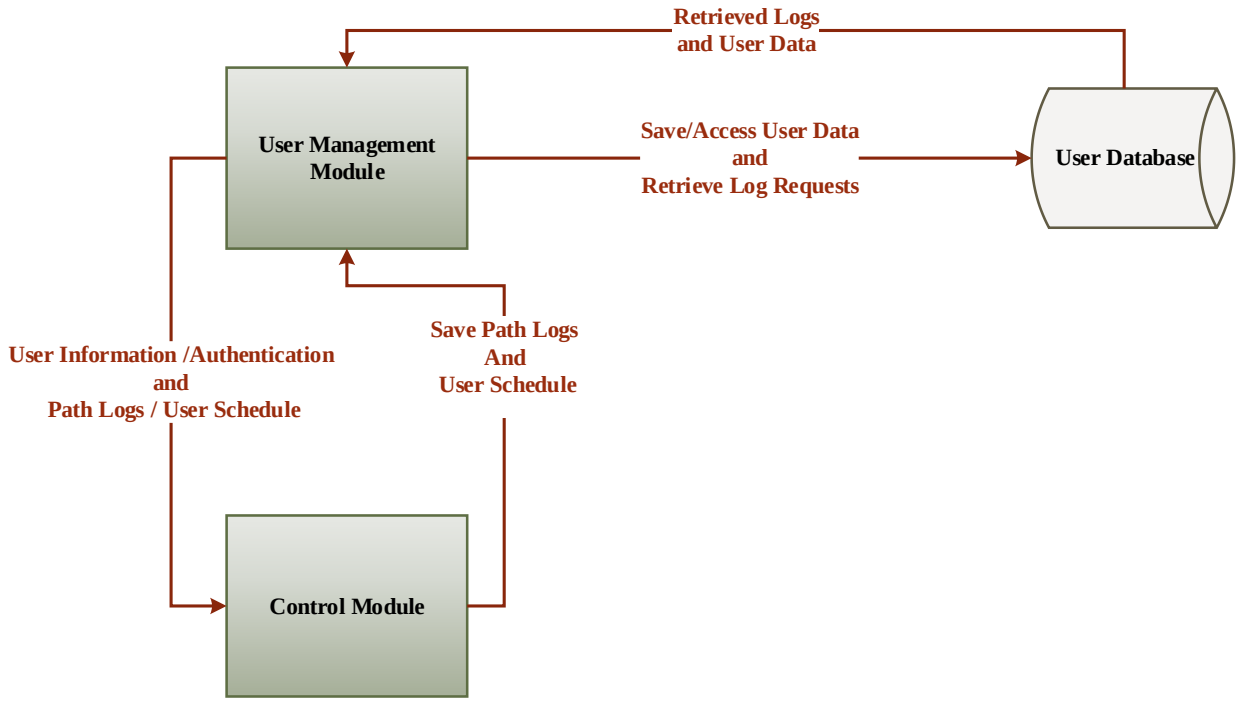


Figure 9: User Management Module

User Management Module has the primary functionality of storing registered user information, utilizing this information to create a unique user experience. It logs user movement and locations, enables privacy of the information and provide information for distress notification.

Assumption:

1. Initialization data is made available through the User Interface module.
2. User has signed up initially, and has up to date information.

Input:

1. User Data generated and updated by User Interface Module.
2. Navigation Path and Current Position Indexes from Navigation and Wi-Fi Triangulation module.
3. Request for Data Retrieval from Distress Module.

Output:

1. Provide User Data to various modules as and when requested.
2. Provide logged paths by the system.
3. Provide updates for the user's schedule.

Functional Requirements:

1. Maintains user information thus providing guidance according to the requirements of the user.
2. Emergency Situation and Distress Call can be catered to by providing necessary information to the system for the user.
3. Enhances user experience by remembering user's schedule and generating alerts.

3.8 Dynamic Object Detection Module

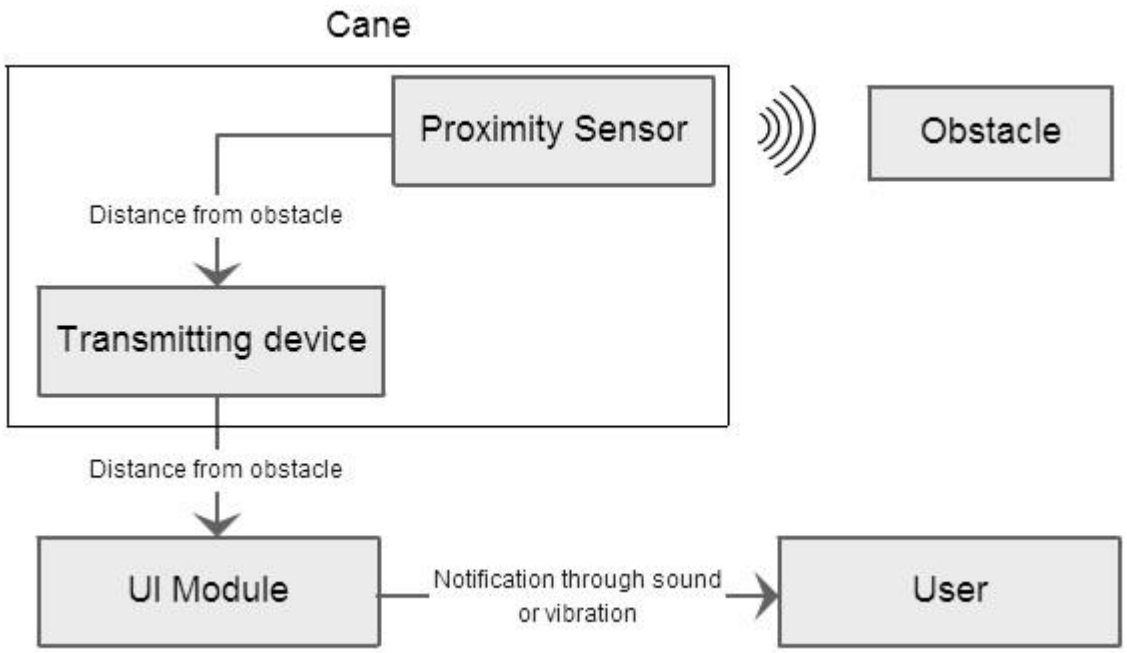


Figure 10: Dynamic Object Detection Module

Dynamic Object Detection:

Steps:

1. The proximity sensor on the cane senses an obstacle in the direction pointed. Next, it calculates the distance of the cane from the object and passes that data to the wireless transmitting device on the cane.

2. The wireless transmitting device takes the data from the proximity sensor and sends it to the phone held by the user.

3. The phone receives the signal from the cane and the application running on it gets the data.

4. The application then converts the data received into a voice notification, so that the blind user is made aware of the obstacle.

3.9 User Interface Module

Overview

- All the communication between the user (through app) and the Guide Blind system is through this module.
- This is the main module for the user system interaction

Input:

- All type of user instructions through the GuideBlind app on smartphone/tablet.
- User will speak and ask for assistance to the app so the user instructions are in the audio format.
- This input is fed to the User Interface Server where the processing takes place.
- There can also be some inputs in text /binary format from the app.

Processing:

UI Server:

- Analysis of all the input is done in the UI Server.
- It sends the voice instructions to the Voice Module.
- Also it communicates to the Guide Blind Control Unit
- The user interface present on the app on the smart phone is also handled by this module.

Voice Module:

- It takes in the audio input from the server and converts it into raw data format, which is then used by the system for processing.
- Also, it converts the raw data format into the audio instructions to be given to the user(app)
- It also does the recognition of the voice of user of the app. Since the system should assist to only the requests from the authenticated user, it is required that the system should recognize the voice of the user.

Init Module:

- This module is the start of the system. It is invoked when the app is started.
- If the user is using the app for the first time, then Init module asks the user about the user profile information, emergency contacts.
- This information is also sent to the User Management Module by Init Module
- This module also stores the user's voice for the first time and uses it for recognition.
- Initial information which is required to be given to all other modules is also provided by this module through control unit.

Functionality:

- Takes all sorts of audio input from the user/app.
- It provides the audio instructions to the user for assistance.
- Directions to the destination such as “Now go left and take four steps” are given to user through this module.
- Also, the feedback from the Smart Building such as “The door has opened for you” is also given through this module.

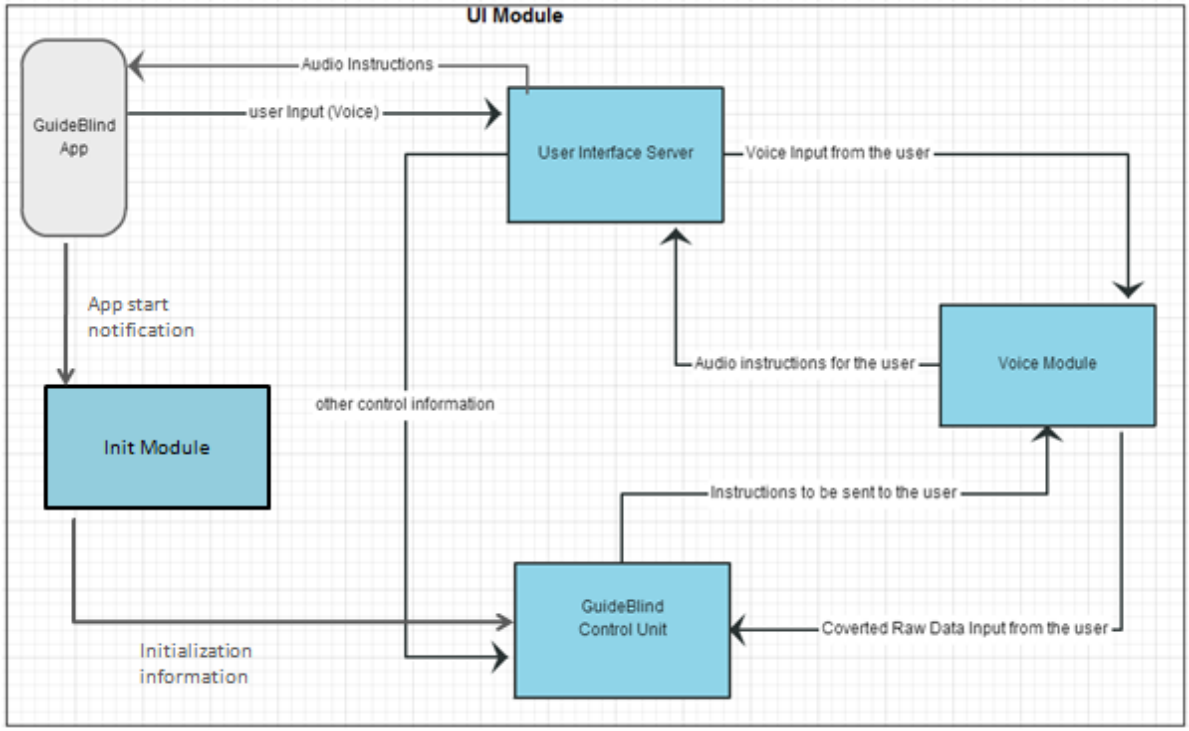


Figure 11: User Interface Module

3.10 User Interface Sample Screen

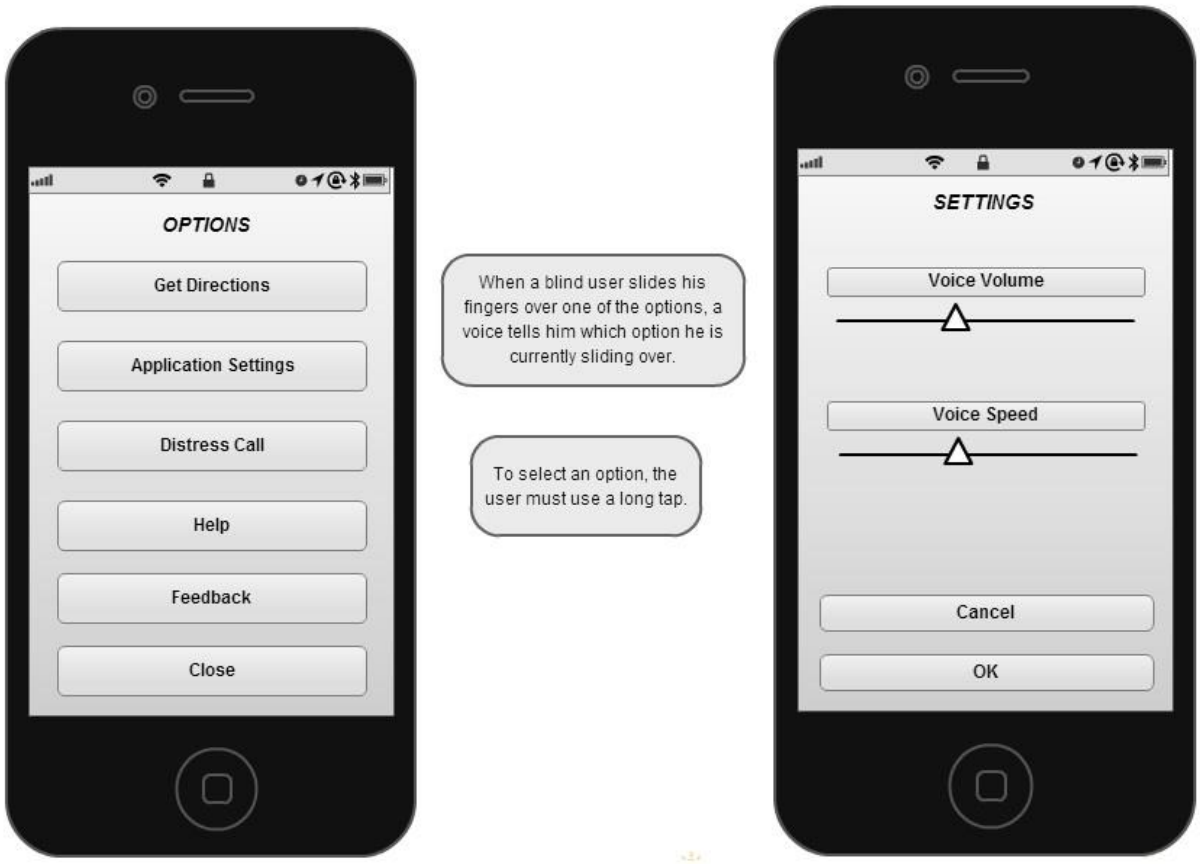


Figure 12: User Interface Application Snap Shots

Section 4. Change Request Form

GUIDE BLIND
PROJECT CHANGE REQUEST FORM

Date:

REQUESTERS INFORMATION

Customer Name		**Project Sponsor**	
Project Name		**Project Manager**	
Change Request Form Number (CRFN)		**Responsible Individuals**	
Requested By		**Project Number**	
Estimated Start Date			
Estimated End Date			

CHANGE SPECIFICATION

Please select the module where the change is requested

☐	Navigation Module	☐	Distress Signal Module
☐	Wi-Fi Triangulation	☐	Feedback System Module
☐	Smart Building	☐	User Management Module
☐	Control Unit Module	☐	Dynamic Object Detection Module

Describe the change being requested:

Change Considerations

Effect on any other Module, Date Schedule, Deliverables, and Project Cost (To be completed by project engineer):					
No	Deliverable / Item	Qty.	Estimated Hours	Revised End Date	Estimated Cost
Total					

Comments:

Reviewing Engineer Name _____ Title _____ Signature _____ Date _____

PROJECT MANAGER APPROVAL

☐ Approve ☐ Reject

Reason for Rejection

_____

_____

_____

Reviewing Manager Name _____ Title _____ Signature _____ Date _____

Section 5. Cross Reference List

System Specification		Software Requirements Specification	
4.1	Audio interaction	3.9	User Interface Module
4.1	Guidance according to user requirements	3.1	Navigation Module
4.2	Smart building	3.3	Smart Building Module
4.3	Dynamic obstacle detection	3.8	Dynamic Obstacle Detection Module
4.4	Emergency situations	3.5	Distress Module
4.5	System requirements	3.5	Distress Module
		3.6	Feedback Module

Section 6. Integration Thread

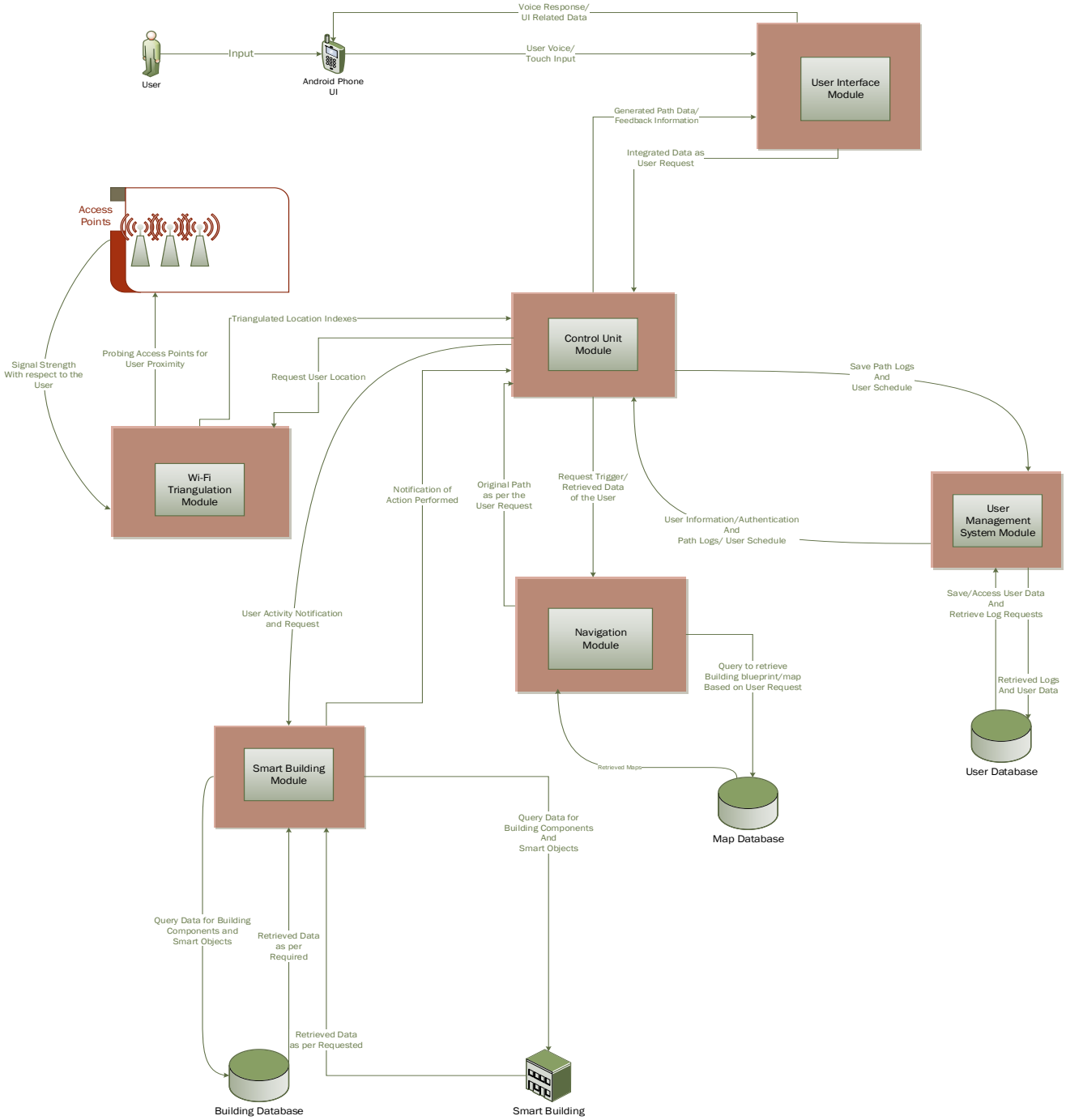


Figure 13: Integration Thread